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Snakes of the Lérida Farm (Chiriqui Volcano, Western Panamá)

By Emmett Reid Dunn

THIS is an account of the snake fauna of upland western Panamá, which is akin to that of upland Costa Rica and dissimilar from that of the rest of the Republic. It is entitled "Snakes of the Lérida Farm" because from that beautiful and hospitable estate of the Monniche's have come more snakes than from the other two localities (El Volcań and Boquete) put together.

Mr. and Mrs. Tollef Monniche started snake collecting in 1940, acting on the initiative of Dr. H. C. Clark of the Gorgas Memorial Institute in Panamá City. Since then they have turned in to Dr. Clark 533 specimens of 16 species, collected, as wholly as is humanly possible, at random by the workmen on their coffee finca. To these 533 I add 3 taken when I was their guest in 1939, and 4 collected some years earlier in the same vicinity by Benson. Thus the total is 540.

Finca Lérida is at an elevation of 5300 feet, on the east slope of Chiriqui Volcano. It is approached from Boquete, lower and to the east. Boquete is the terminus of the railroad from David.

In the following list of the Lérida collection numbers refer to the individual specimens of each species. The term "southern limit" refers to the general area of Chiriqui Volcano, and is not intended to discriminate between Lérida and, say, Boquete.

XENODONTINAE

Ninia psephota (Cope).—38; southern limit.

Geophis godmani Boulenger.—3; southern limit. Only Panamanian locality.

Geophis brachycephalus (Cope).—255; southern limit.

Rhadinaea serperastra (Cope).—19; southern limit.

Rhadinaea pachyura decipiens (Günther).—4; southern limit of race. Only Panamanian locality. The species extends from Costa Rica to Colombia; this race extends from the uplands of Costa Rica to Lérida.

Rhadinaea calligaster (Cope).—1; southern limit.

Trimetopon slevini Dunn.—26; endemic to area (Lérida and Boquete).

Leimadophis epinephalus juvenalis Dunn.—31; southern limit of race. The species extends from Costa Rica to Colombia and perhaps farther.

COLUBRINAE

Dendrophidion paucicarinatus (Cope).—76; southern limit.

Dryadophis boddaertii alternatus (Bocourt).—4.

Drymarchon corais melanurus (Duméril, Bibron, and Duméril).—3.

Chironius carinatus (Linné).—2.

Lampropeltis triangulum gaigae Dunn.—31; southern limit of race. The species ranges from Canada to Ecuador.

ELAPINAE

Micrurus nigrocinctus nigrocinctus (Girard).—1.

CROTALINAE

Bothrops lateralis (Peters).—18; the southern limit is "Veragua."

Bothrops nigroviridis nigroviridis (Peters).—2; southern limit of species.

The character and construction of the Lérida snake fauna may be summarized as follows, in a format I have devised for the treatment of other and much more extensive Panamanian material. The subfamilies are represented as follows:

	No. of species	Per cent of species	No. of individuals	Per cent of individuals
Xenodontinae	8	50	403	74.6
Colubrinae	5	31.3	116	21.5
Elapinae	1	6.2	1	.2
Crotalinae	2	12.5	20	3.7
	16	100.0	540	100.0

Species are represented by from 255 individuals (*Geophis brachycephalus*) to one individual (2 species).

Eight species are each more than 1 per cent of the collection. These add up to 520 individuals, or 96.3 per cent of the collection.

Eight species are each less than 1 per cent of the collection. These add up to 20 individuals, or 3.7 per cent of the collection.

The contrast between ½ of the collection, as made up by the few dominant species, and that part of the collection made up by the rarer ½ of the species is:

½ collection	= 270 individuals	(1.2 species)	= 7.5% of the species
½ species	(8 species) = 20 individuals		= 3.7% of the collection

The Fisher parameter *"alpha"* for the Lérida collection of "N" 540, "S" 16 is 3.0966 (cf. Fisher, Corbet, and Williams, 1943). A fuller treatment of the Fisher parameter *"alpha"* as applied to snake populations will appear elsewhere, tested against much larger collections. It is sufficient to say here that it has been subjected to rigorous examination and found to be useful in comparison of "specific diversity," as a test for the randomness of the collection, and as a guide to future possibilities of addition to the faunal lists.

The incidence of venomous species of Elapinae and Crotalinae at Lérida is 23 per thousand. This may be compared with the incidence at Puerto Armuelles, on the coast of Chiriqui, which is 311 per thousand (the highest lowland incidence known to me).

The Lérida material of 540 specimens and 16 species from a Panamanian coffee finca at 5300 feet elevation can be compared with material of 552 specimens and 18 species from El Cipres, a coffee finca at 2000 feet elevation on the southern face of the Volcan Zunil, Prov. Suchitepeques, Guatemala (Slevin, 1939).

The six subfamilies of snakes involved in the two combined lists all range from Mexico into South America, but the Guatemalan finca lacks Crotalinae and the Panamanian one lacks Boinae and Sibynophiinae, so that the two have in common only Xenodontinae, Colubrinae, and Elapinae.

The 24 genera of snakes involved range from Guatemala to Panamá (and mostly beyond, both to the north and the south) except for *Adelphicos*, which is northern, and *Chironius*, which is southern. None the less, only 6 genera (*Ninia, Geophis, Trimetopon, Dryadophis, Drymarchon,* and *Micrurus*) appear on both lists. The Guatemalan finca has 12 additional genera; the Panamanian 6.

Of the 6 genera held in common 11 species are involved. *Ninia sebae* of Guatemala is certainly not vicariously related to *N. psephota* of Panamá. *Geophis chalybeus* of Guatemala may be vicariously represented by either

G. brachycephalus or by *G. godmani* of Panamá, but not by both. *Trimetopon posadasi* of Guatemala may well be represented vicariously by *T. slevini* of Panamá. However, the general opinion is that in the above cases 7 distinct species of these 4 genera are involved.

Dryadophis boddaertii slevini of Guatemala is vicariously represented by *D. b. alternatus* of Panamá. *Micrurus nigrocinctus zunilensis* of Guatemala is a vicarious race of *M. n. nigrocinctus* of Panamá. *Drymarchon corais melanurus* has been taken at both fincas.

Thus on whatever level of taxonomic grade one compares the known snake fauna of these two fincas, they are by no means identical. It is therefore the more remarkable that the structure or composition of the two faunas *is* almost identical, and this practical identity of structure may indicate a conformity to some general law.

A collection of 540 specimens at Lérida produced 16 species; a collection of 552 at El Cipres produced 18 species. This is equivalent to a Fisher *"alpha"* for Lérida of 3.0966, for El Cipres of 3.5653; i.e., the specific diversity of the two faunas is very similar.

The incidence of venomous forms at Lérida is 23 per thousand; at El Cipres it is 39 per thousand.

Species with an incidence of 10 or more per thousand make up 96.4 per cent of the El Cipres collection, and 96.3 per cent of the Lérida collection. Those with an incidence of less than 10 per thousand make up, conversely, 3.6 per cent of the El Cipres collection and 3.7 per cent of the Lérida collection. In both collections about half the species are in the latter category.

At Lérida the individuals of the most abundant species need added to them only 1/5 of the individuals of the next most abundant species to make half the total catch. At El Cipres ¼ of the next most abundant must be added. Less than 1/10 of the species (7.5 per cent at Lérida, 7.8 per cent at El Cipres) make up half the population.

In both fincas a species of *Geophis* is the most abundant snake. In both a species of *Ninia* is the fourth most abundant snake.

At both Lérida and El Cipres the individuals of xenodontine snakes much outnumber the individuals of colubrine snakes. In the lowlands of Panamá the reverse is very markedly the case, although throughout Central America the number of *species* in the two groups is not very dissimilar. In both fincas the individuals of xenodontine snakes much outnumber the individuals of crotaline snakes. In the lowlands of Panamá the reverse is frequently true, although I know of no Central American locality in which xenodontine species do not much outnumber crotaline species. The coffee zone would thus appear to resemble less the lowlands immediately adjacent than the more remote heights of the Andes, the islands of the Caribbean and the Pacific, and the extremities of southern South America, as there xenodontine snakes also dominate, but in the practical absence of colubrines and crotalines.

The El Volcán area lies at an altitude of 4500 to 6000 feet, almost on the opposite side of the volcano from Lérida and Boquete. It is reached by road from Concepción. Dr. Clark has received 24 snakes from there from various sources, Gertsch and Lutz got 3, and Enders and Dunn each one. The total of 29 specimens represents 7 species.

With one exception, all the El Volcan species are also found at Lérida.

The exception is *Bothrops godmani* (Günther), which is not known from any other Panamanian locality and is here at the southern end of its range. I list the El Volcán species below, with the number taken and the number of the same species taken at Lérida.

	El Volcán	Lérida
Rhadinaea serperastra	3	19
Leimadophis e. juvenalis	4	57
Lampropeltis t. gaigae	4	31
Micrurus n. nigrocinctus	1	1
Bothrops godmani	11	..
Bothrops n. nigroviridis	5	2
Bothrops lateralis	1	18

As a fauna, El Volcán is a reduced Lérida fauna with an additional species. As a fauna of snake populations it differs extraordinarily from that of Lérida. Note the incidence of venomous species, 631 per thousand as against 23 per thousand at Lérida. Note the absence of the commonest Lérida harmless snakes, especially the small *Geophis* and *Ninia*. Note that *B. nigroviridis* is represented by 5 specimens out of 29 as against 2 specimens out of 540 at Lérida. Only the *Leimadophis* and the *Bothrops lateralis* are at all in the same relative abundance as at Lérida. I infer that the 24 specimens sent to Clark are by no means a random sample of the population, but a rather carefully selected lot of supposed (and actually) venomous specimens sent in for identification.

The Boquete area is east of Lérida. The railroad station is at 3800 feet. Most collectors have had their headquarters at about 4000 feet, and most have worked up hill rather than down, and north towards the continental divide rather than west towards Lérida. The 220 snakes collected by Slevin in 1939 form the bulk of the Boquete material (cf. Slevin, 1942): next most important is the collection made by the Gaiges in 1923. In all I count 270 specimens from six sources.

The Boquete material of 270 specimens includes 28 species. Thirteen species are common to Boquete and Lérida and are listed below. Those more abundant at Boquete are at the top of the list, and those more abundant at Lérida are at the bottom.

	Boquete	Lérida
Micrurus n. nigrocinctus	15	1
Dryadophis b. alternatus	34	4
Chironius carinatus	7	2
Rhadinaea calligaster	1	1
Ninia psephota	31	38
Drymarchon c. melanurus	2	3
Bothrops n. nigroviridis	1	2
Leimadophis e. juvenalis	17	57
Geophis brachycephalus	66	255
Bothrops lateralis	2	18
Dendrophidion paucicarinatus	8	76
Lampropeltis t. gaigae	2	31
Trimetopon slevini	1	26

Fifteen Boquete species are not known from Lérida and are listed below.

TYPHLOPHINAE

Helminthophis frontalis (Peters).—1; southern limit. Only record for Panamá.

BOINAE

Constrictor constrictor imperator (Daudin).—2.

XENODONTINAE

Ninia maculata (Peters).—27.

Geophis hoffmanni (Peters).—2; southern limit. Only Panamanian locality.

Dipsas nebulatus (Linnæus).—3.

Hydromorphus dunni Slevin.—1; endemic. Taken between Boquete and Lérida.

Coniophanes fissidens fissidens (Günther).—8.

COLUBRINAE

Thalerophis occidentalis occidentalis (Günther).—8.

Oxybelis aeneus (Wagler).—8.

Imantodes cenchoa (Linnaeus).—4.

Chironius fuscus (Linnaeus).—1.

Spilotes pullatus pullatus (Linnaeus).—3.

Leptodeira rhombifera (Günther).—3.

Stenorhina degenhardtii (Berthold).—5.

Twelve of these 15 species are widespread lowland forms. So are the three species notably more abundant at Boquete than at Lérida, and one only slightly so (*Drymarchon c. melanurus*). Thus 16, or over half of the Boquete snake species, are at or near their upper altitudinal limit of range; the other 12 are at or near their lower altitudinal limit and their southern (actually eastern) horizontal limit.

The upland Chiriqui snake fauna may be summarized as follows:

Lérida only: 2; *Geophis godmani, Rhadinaea p. decipiens.*

El Volcán only: 1; *Bothrops godmani.*

Boquete only: 15; *Helminthophis frontalis, Geophis hoffmanni, Hydromorphus dunni,* and 12 widespread lowland forms.

Lérida and El Volcán only: 1; *Rhadinaea serperastra.*

Lérida and Boquete only: 8; *Ninia psephota, Geophis brachycephalus, Rhadinaea calligaster, Trimetopon slevini, Dendrophidion paucicarinatus,* and three widespread lowland forms.

Lérida, El Volcán and Boquete: 5; *Leimadophis epinephalus juvenalis, Lampropeltis triangulum gaigae, Bothrops nigroviridis nigroviridis, Bothrops lateralis,* and one widespread lowland form.

The total list is thus 32 from upland Chiriqui, of which 16 are known in Panamá only from this area.

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Rana sylvatica cantabrigensis Baird in Colorado

By T. Paul Maslin

When Baird (1854) first described *Rana cantabrigensis* he differentiated it from the otherwise similar species *R. sylvatica* on the basis of the length of the tibia, which was one-half the body length, and the presence of a light dorsal median stripe and light lines on the posterior faces of the thigh and leg. Cope (1875) also recognized the similarity between these forms, and included them as subspecies of *R. temporaria*. But later (1886) he gave *R. cantabrigensis* full specific rank. In making this decision he was undoubtedly influenced by discovering that his subspecies *R. t. cantabrigensis* was divisible into two geographic races, the typical form and an Alaskan form, which (*loc. cit.*) he named *R. cantabrigensis latiremis*. Stejneger and Barbour (1923) suppressed *R. c. latiremis*, placing it in the synonomy of *R. cantabrigensis*, where it remained until Schmidt and Necker (1935), in their discussion of the species of the Chicago area, were faced with the problem of differentiating *R. cantabrigensis* from *R. sylvatica*. In this region the character commonly used to separate the species, namely the proportion of the tibia to the body length, proved inadequate as a specific character. The wood frogs in this area had a tibia averaging .54 of the body length, a proportion well within the range of the measurements accepted as typical for *R. sylvatica*, but the color pattern of these specimens resembled that of *R. cantabrigensis*. In view of this discrepancy Schmidt and Necker (*loc. cit.*) rightly reduced the tibia-body proportion character from specific to a subspecific rank and allocated the frogs of the Chicago area to *R. cantabrigensis*. At the same time they revived *R. c. latiremis* for the stocky, short-legged forms of the extreme northern reaches of the species range. Later, in a more detailed study of the leg length gradient of frogs, Schmidt (1938), without comment, placed *R. c. cantabrigensis* and *R. c. latiremis* in the species *R. sylvatica*.

Trapido and Clausen (1938) had independently come to the same conclusions, pointing out that the color pattern of *R. s. cantabrigensis* was variable and also should be considered as a character of subspecific rank. On the basis of the tibia-body proportion and the leg (to heel) body proportion they recognized, however, only two subspecies, *R. s. sylvatica* and *R. s. cantabrigensis*. Patch (1939) concurred in this view, but preferred the leg length character alone for differentiating the two races. This had an advantage because it extended the range of *R. s. cantabrigensis* somewhat farther south, thus the range more closely coincided with that area in which the intergradation in color patterns occurred. Wright and Wright (1942) agreed with Schmidt in recognizing three races, but adhered to the tibia-body proportion of .50 for separating *R. s. sylvatica* and *R. s. cantabrigensis*. The same position was apparently taken by Stejneger and Barbour (1943), as indicated in their recognition and description of the ranges of these three subspecies. Breckenridge (1944), however, discussed the effects of selecting either one or the other of the leg proportion criteria for subspecific differentiation in Minnesota. On the basis of tibia length Minnesota would be in an area of subspecific intergradation but on the basis of leg to heel length all forms in the state could be referred to *R. s. cantabrigensis*. Breckenridge, like

Schmidt (1938), feels that additional data are necessary before a full understanding of the subspecific ranges can be attained.

On June 26, 1946, I collected 2 specimens of *R. s. cantabrigensis* in a dense willow thicket around a small beaver pond 2½ miles southwest of Rabbit Ears Peak, Jackson County, Colorado. Three weeks later, the east slope of the Park Range was searched for these frogs in the vicinity of Buffalo Pass, about 15 miles north of Rabbit Ears Peak. Nine additional specimens were collected here on July 17, and 3 more were captured at Rand, 20 miles farther east, on July 18. On returning to the Rabbit Ears Peak collecting site on July 18, 3 more specimens were captured.

DESCRIPTION OF COLORADO SPECIMENS.—These 17 specimens closely resemble the typical form of *R. s. cantabrigensis*. The head is one-third the body length in adults, the muzzle pointed. The distance between the eyes is equal to or a little greater than the distance between the nostrils, which lie half way between the eye and the tip of the snout below an inconspicuous canthal fold. The round, smooth tympanum is two-thirds as wide as the length of the orbit. The labial fold protrudes distinctly at its posterior end and lies above the center of the base of the forearm. The dorso-lateral folds are weak but distinct, diverging posterior to midbody but reconverging on the rump. Between these folds two secondary folds occur, which may be broken up into longitudinal welts. In addition to these glandular areas there is a cluster of five or six sub-circular areas on the rump and other areas irregularly disposed below the lateral folds.

MEASUREMENTS IN MM. OF *Rana sylvatica cantabrigensis* (BAIRD) FROM COLORADO

Collector's No.	Loc.*	Sex	Body	Head	Snout	Leg	Leg to Heel	Femur	Tibia	Foot
TPM3268	d	♀	55.0	17.1	7.6	86.0	48.6	22.2	26.4	37.4
3293	b	♀	54.8	17.7	7.7	83.0	44.7	20.1	24.6	38.3
3363	d	♀	54.3	17.3	7.3	80.5	46.1	21.1	25.0	34.4
3365	d	♀	53.5	17.4	7.4	80.1	43.6	20.0	23.6	36.5
3364	d	♀	51.5	17.0	6.7	80.0	43.0	21.0	23.0	37.0
3357	c	♀	51.0	17.0	7.0	75.0	42.4	19.2	23.2	32.6
3269	d	♀	47.0	14.8	6.0	73.7	40.8	18.7	22.1	32.9
3358	c	♂	45.0	15.6	7.0	67.0	38.8	18.0	20.8	28.2
3324	a	♂	39.3	13.9	5.0	59.3	33.5	15.0	18.5	25.8
3325	a	♂	35.8	13.7	5.0	52.3	30.5	14.0	16.5	21.8
3326	a	♀	34.0	12.6	5.8	49.5	28.3	13.0	15.3	21.2
3359	c	♂	33.5	12.2	5.0	47.1	26.7	11.5	15.2	20.4
3327	a	♀	31.8	11.7	5.0	44.8	25.7	11.7	14.0	19.1
3328	a	♀	31.5	11.4	5.0	47.2	27.0	12.0	15.0	20.2
3296	b	jv.	21.0	8.5	4.0	28.5	16.9	7.7	9.2	11.6
3294	b	jv.	20.0	7.2	3.6	27.0	15.1	7.1	8.0	11.9
3295	b	jv.	19.8	8.2	4.0	28.0	16.6	7.8	8.8	11.4

* All specimens recorded above are from Colorado, Jackson County. Specific localities:— a, 8 miles W. Coalmont, 2 miles N. Sawmill Creek, 8800 feet; b, 8 miles W. Coalmont, 1 mile N. Sawmill Creek, 8500 feet; c, Rand, 8700 feet; d, 2½ miles SE Rabbit Ears Peak, 9000 feet.

The thumb of the males is scarcely differentiated from that of the females. The hind leg is short (see table) and slender, the heel reaching forward to

the center of the eye. The tibia averages .46 of the body length in adults, and the femur is a little more than four-fifths as long as the tibia. The articular pads are weak; the large inner sole tubercle is about two and one-half times as long as wide, and the outer tubercle is indistinct. The deeply indented webbing leaves the terminal phalanx of the first, second, and fifth toes and the two terminal phalanges of the remaining toes free.

In living specimens the pattern contains a considerable amount of the metallic colors; bronze, silver, and pearl. The bronze colors are most conspicuous on the lateral folds and on the dorsal surfaces of the forearm, tibia and foot. The labial fold is pearl white, and pearl or silvery spots occur on the glandular areas below the lateral folds. The conspicuous median dorsal white stripe extends from the snout to the rump. The leg stripes begin one-third of the way down the dorsal surface of the thigh, pass to the bend of the knee, then, following a short break, continue down the anterodorsal face of the tibia, arch over the heel and continue along the plantar surface to near the end of the fifth toe. The unique feature about the color pattern in general is its remarkable constancy in all specimens collected, from the 20 mm. juveniles to the 54 mm. adult female.

The first specimens caught were found among grass and herbaceous annuals in a dense willow thicket surrounding a small beaver pond. These frogs jumped without exceptional agility into the pond, where, upon reaching the bottom, they remained quiet. No effort was made to kick up mud or to seek cover. They could be seen clearly beneath the water and were easily captured. Later observations, near Buffalo Pass, also demonstrated this general lack of both alertness and of a well-developed escape behavior. It was observed that in making their escape the frogs would take several short leaps towards the cover of willow bushes, but once beneath their sheltering branches the frogs remained quiescent, allowing the wands to be carefully spread without making any further movements. They seem to rely for protection more on their amazing color pattern than on physical agility.

All the specimens captured were found close to clean flowing water, usually in the form of ground seepages or in fresh-water swampy meadows. Other habitats in the same area were carefully searched without results. No frogs of this species were found near creeks or streams or in the vicinity of lakes. The log-choked forest ponds so peculiarly favored by *Rana pipiens* yielded no specimens of *R. s. cantabrigensis,* nor were any found in the stagnant swampy areas. Fourteen specimens were collected in the aspen-coniferous forests of mountainous areas, and 3 in an irrigated meadow near Rand, which lies at the southern end of an extensive plateau, the North Park.

Other amphibians associated with *R. s. cantabrigensis* were *Rana pipiens, Bufo boreas, Pseudacris nigrita,* and *Ambystoma tigrinum.* The latter was found only at the Rabbit Ears Pass collecting station.

Most of the specimens captured were females. In all but one of the mature individuals the ovaries were filled with pigmented eggs, the largest of which measured 1.3 mm. in diameter. This condition of the ovaries suggests a late breeding season. But in the largest female, caught June 26, the eggs had already been discharged and the ovaries were in a resting condition. How-

ever, 3 young frogs were caught on July 17. Each measured approximately 20 mm. in body length.

Discussion.—The occurrence of typical specimens of *R. s. cantabrigensis* in Colorado is of interest, for, in conjunction with Breukelman and Smith's (1946) record in southwestern Kansas, it demonstrates that the species has a much wider western distribution than had been previously suspected. Breukelman and Smith's Kansas record probably represents the southern limit of a general Rocky Mountain population extending south from Alberta and British Columbia, although as yet no records have been published from Idaho, Montana, Wyoming or Utah.

This Rocky Mountain population is of further interest in connection with an interpretation of the subspecific distribution. In 1935 Schmidt and Necker revived the subspecies *latiremis* to contain the short-legged stocky forms of the extreme north. In 1938 Schmidt accounted for the similarity of the Alaskan and Labrador specimens by assuming that a similar habitat extended across the continent. As this distribution conforms to that of other northern species of plants and animals *R. s. latiremis* should be considered a member of the tundra-coniferous forest ecotone as defined by Clements and Shelford (1939). An examination of the map of biotic communities prepared by Pitelka (1941) shows that the known range of *R. s. latiremis* closely fits this ecotone. The subspecies *R. s. sylvatica,* on the other hand, is a member of the deciduous forest biome. Now that *R. s. cantabrigensis* has been shown to exist in the Rocky Mountain area this subspecies can be described at present as the coniferous forest biome representative of the species. This coniferous forest form has a dorsomedian light line and light leg stripes. But outside of this biome both to the north and to the south there is a tendency for the frog to lose the stripes, consequently both typical *R. s. latiremis* and *R. s. sylvatica* are stripeless. Therefore this character is more suitable for subspecific differentiation than the more commonly used character of tibia-body proportion which, as Schmidt (1938) has shown, forms a continuous latitudinal gradient or geocline rather than a semisaltatorial ecoline. A knowledge of the actual limits of the subspecific ranges must wait until much more extensive collections are available, and this also applies to an understanding of the characters of the subspecies.

Tentatively, however, *R. s. latiremis* may be described as a relatively stocky frog with a tibia-body proportion of .45 or less, a leg to heel measurement equal to or shorter than the body, two phalanges free of web, and lacking the dorsal longitudinal light stripes of body and legs. *R. s. cantabrigensis* is a frog with a tibia-body proportion ranging from .45 to .55, a leg equal to or shorter than the body length, 2 or 3 phalanges free of web, and possessing at least a dorso-median light body stripe. *R. s. sylvatica* is a frog with a tibia-body proportion of more than .55, a leg length greater than the body length, 3 phalanges free of web, and lacking both a dorso-median light stripe and stripes on the legs.

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A New Species of *Desmognathus* from North Carolina

By Walter C. Brown and Sherman C. Bishop [1]

A NEW species of *Desmognathus* is based upon a series of 10 adult and 2 juvenile specimens collected under dead leaves near a small seepage branch 100 feet north of Peachtree Creek, ½ mile S.S.E. of Peachtree, Cherokee County, North Carolina. These were taken by J. C. Nicholls, Jr., October 22, 1946.

Desmognathus ***aeneus,*** n. sp.

Diagnosis.—A small, slender *Desmognathus,* possessing vomerine teeth in adults; tail terete, not keeled; venter blotched with dark pigment; dorsal band straight-edged and reddish-bronze in color.

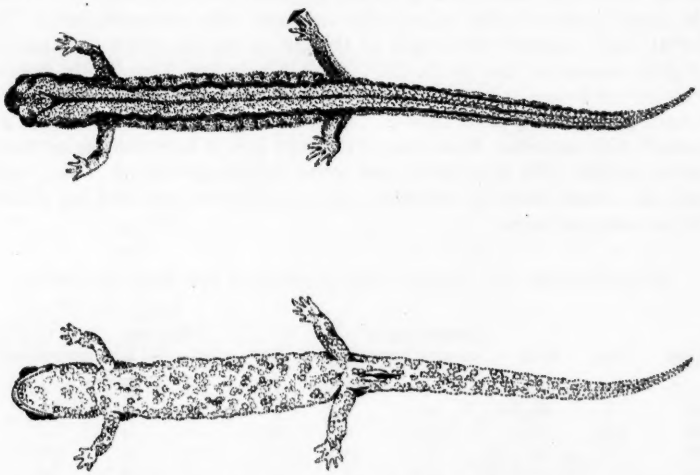

Fig. 1. Upper, *Desmognathus aeneus,* n. sp., ♂ dorsal aspect. Lower, same, ventral aspect. Peachtree Creek, Cherokee Co., North Carolina. Actual length 46.5 mm.

Description.—Snout bluntly rounded in young and female, sometimes slightly swollen and truncate in males; sides of head nearly parallel or, especially in older males, swollen between the gular fold and the angle of the jaw; a groove from the eye to the lateral extension to the gular fold, a vertical groove from this to the angle of the jaw; trunk round, flattened ventrally; tail subquadrate in cross-section at base, circular in cross-section and tapering posteriorly; limbs stout; toes 4-5, forefeet 1-4-2-3 in order of length, hind feet 1-5-2-(4-3), webbed at base; vent of male papillate, female with lips in folds; costal grooves 13, occasionally 14 where the posterior two are separated in the groin; 4 or 5 folds between toes of appressed limbs; ratio of tail length to total length for 4 adults (2 ♂'s and 2 ♀'s) varies from 47.3 per cent to 49.5 per cent, one juvenile 41.9 per cent.

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Vomerine teeth in short, curved series, anteriorly nearly parallel with the medial boundaries of the internal nares, narrowly separated posteriorly, 4 to 8, usually 5, in each series; parasphenoid teeth in two patches, or these may be united anteriorly, rather narrowly separated from the vomerine series; or, in some specimens, connected by a few scattered teeth; posterior margin of the mandible with teeth; premaxillary teeth, for each of two cleared specimens, without marked enlargement in males; maxillary teeth about twenty on either side. The nasal spines may or may not be in contact; fontanelle large; pterygoid absent.

In life the iris is tinged with reddish bronze. The wide dorsal band is reddish bronze suffused with dusky or marked with dark spots of irregular size and shape and sometimes with a narrow, middorsal dark line continuous with a dark Y-shaped mark on the head; upper sides in contact with the dorsal band, dark brown fading toward the lower sides. In some individuals the dorsal surface is also flecked with scattered white chromatophores. The dorsal band continues the length of the tail to the tip where it is usually brighter orange-red, and on the head where it is darker. Legs lightly mottled with grayish-brown over which are scattered some white chromatophores; feet lighter, grayish. The lower sides of the trunk and tail in some individuals are spotted with numerous white chromatophores over a brownish background; venter mottled with deep brown and white chromatophores on throat, belly and legs, though throat is somewhat lighter; midline of venter of tail yellowish in some specimens.

MEASUREMENTS AND OTHER CHARACTERISTICS FOR FIVE SPECIMENS

Type	Sex	Total	Length (mm.) Snout to vent	Head	Tail	Costal Grooves L	Costal Grooves R	Folds between appressed limbs
S.C.B.	♂	49	25.6	5.8	23.4	13	13	4
907	♀	46.3	24.4	5.6	21.9	13	13	5
908	Juv.	24.1	14.0	3.7	10.1	14	14	5
909	♂	46.5	23.4	5.8	23.1	13	14	5
910	♀	47.5	24.4	5.5	23.1	13	13	4

Two young individuals have the dorsal band bright coppery suffused with dusky, lighter than in adults; upper sides dark brown, lower sides, snout and legs lighter brown. The lower sides are strongly flecked with white chromatophores.

TYPE AND PARATYPES.—Adult male (49 mm.) U.S. National Museum, No. 123977. Paratypes are deposited in the S.C. Bishop collection; W. C. Brown collection; American Museum of Natural History, New York; Carnegie Museum, Pittsburgh; Museum of Comparative Zoology, Cambridge, Massachusetts, and the Chicago Natural History Museum.

AFFINITIES.—This species apparently has its closest affinities among known species with *D. ochrophaeus* and *D. wrighti*. It is most like the latter in its small size, retention of the vomerine teeth in the male and the ratio of tail length to total length; and like *carolinensis*, the southern race of *ochrophaeus*, in form of body, particularly the shape of the head, and pigmentation of the venter. It differs markedly from both, however, in color and pattern.

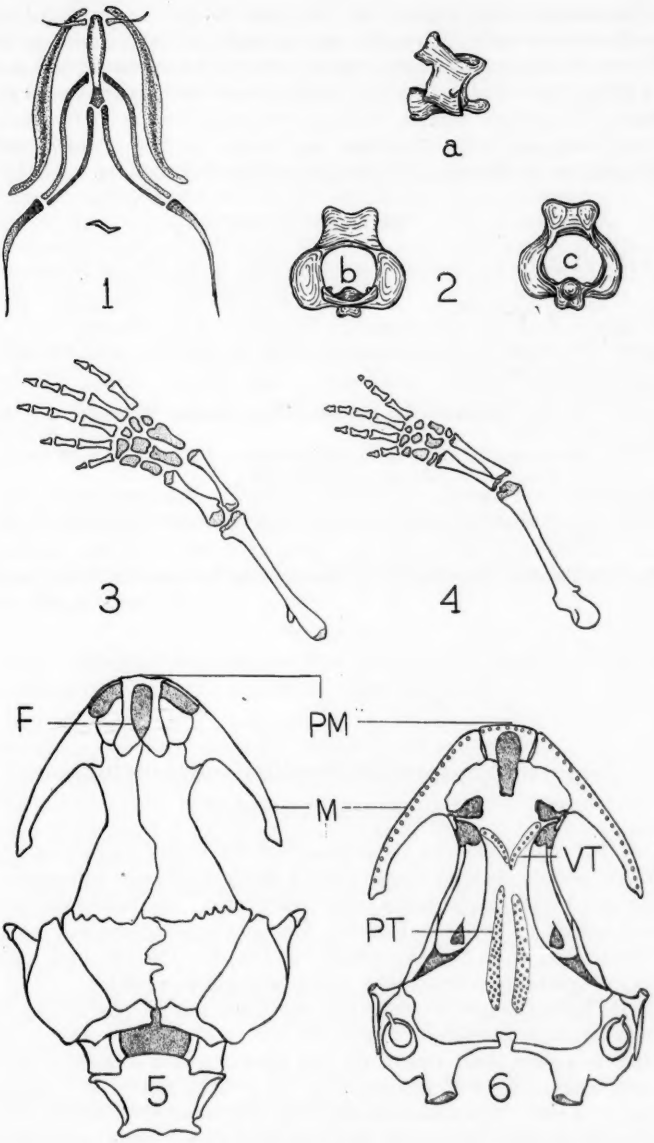

PLATE I

Fig. 1. Hyobranchial apparatus of *Desmognathus aeneus*. Fig 2. First vertebra: a) lateral view; b) anterior view; c) posterior view. Fig. 3. Left hind leg, dorsal view. Fig. 4. Left fore leg, ventral view. Fig. 5. Skull, dorsal view. Fig. 6. Skull, ventral view: F, fontanelle; PM, premaxilla; M, maxilla; VT, vomerine teeth; PT, parasphenoid teeth.

COMMENTS.—Two females (45 mm. and 46 mm.) were found to be sexually mature with 13 ovarian eggs in each specimen, each egg about 1.25 mm. in diameter. The eggs were arranged in a linear series and covered by a lightly pigmented epithelium. Neither larvae nor eggs are known at this time.

ACKNOWLEDGMENTS.—Drawings were made by Miss Carolyn Fallon, staff artist, at the Biological Laboratories of the University of Rochester.

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Notes on Panamanian Reptiles and Amphibians

By HOWARD E. EVANS

WHILE stationed in the Canal Zone with the United States Army, from December, 1945, to April, 1946, I had considerable opportunity to inspect and collect in the surrounding countryside. The four-month period covered was the dry season in Panamá. Most of the collections were made on the Pacific side, which is always much drier than the Atlantic slope, and the number of specimens is fewer than otherwise might be expected.

In the last few years the Army has built many fine interconnecting roads through otherwise inaccessible places and these enable one to cover a lot of territory in a short time. One of the best collecting sites is the ruins of Old Panamá, 7 miles north of Panamá City. It is being cleared of overgrowth for use as a park. The numerous old wells and water-filled cellars provide good breeding places for species of *Gonatodes, Anolis, Bufo,* and the like. Old Panamá has been in ruins since Morgan sacked it in 1671 and the building stones which are strewn everywhere also facilitate collecting.

Charles M. Bogert and James A. Oliver, of The American Museum of Natural History, made helpful suggestions while I was working up the col-

lection, and kindly made available the use of their laboratory and library facilities. Identifications were checked with specimens in the museum's collection when possible. My identifications were checked by Dr. Emmett R. Dunn, who also determined some of the frogs and anoles.

The bulk of the collection was presented to The American Museum of Natural History.

While in the Canal Zone the assistance of Mr. Hayward Shacklett of the Building Division, a veteran hunter who knows the countryside; of Dr. James Zetek of the Department of Agriculture, who arranged the Barro Colorado trips; and of Mrs. Mary Ray and Miss Betty Ray of Cocoli, avid naturalists, made collecting possible. These people would be only too glad to help others while collecting in Panamá. Some snakes from Aguadulce, R.P., were collected by Lt. Frederick Silverman, Sig. C., U. S. Army.

The collection includes 1 species of caecilian, 10 frogs and toads, 9 lizards, 16 snakes, 2 turtles, and 1 crocodilian. Another frog not included in this report appears to be a new species, which will be reported on at a later date.

Apoda

Caecilia ochrocephala (Cope).—Three from Albrock Field, C.Z. Found in 4 feet of mud by natives when digging drainage ditches through swampy woodland. Caecilians are erroneously considered to be poisonous by the natives, and are quickly killed when found. Chickens are often found eating them after a heavy rain.

Salientia

Bufo typhonius (Linnaeus).—Two from Barro Colorado Island, C.Z. Common along the stream behind the main laboratory.

Bufo haematiticus (Cope).—Two from El Valle, Middle Falls, R.P. When approached these toads jumped into pools and hid under rocks.

Bufo marinus (Linnaeus).—One from Old Panamá, R.P. and three from Albrook Field, C.Z. Most specimens of this species were large sized and many had engorged ticks (*Amblyoma dissimile* Koch, 1844) hanging from the gular region.

Centrolene fleishmani (Böettger).—El Valle, Middle Falls, R.P. Found on a begonia leaf with which it blended perfectly. Even after the leaf was picked the frog remained undisturbed. It was a delicate green above and transparent beneath.

Eleutherodactylus ockendeni (Boulenger).—One from Barro Colorado Island, C.Z. This species inhabits stream banks along with *Bufo typhonius* and *Phyllobates flotator.*

Leptodactylus bolivianus Boulenger.—One from Old Panamá, R.P. Found under stones and logs in exposed places.

Dendrobates auratus (Girard).—Three from Barro Colorado Island, C.Z. These frogs are frequently caught in the "Big Tree" area on the island and my three specimens were found at the base of one of the big trees.

Phyllobates inguinalis Cope.—One from El Valle, Middle Falls, R.P. Caught in the same pool as *Bufo haematiticus.*

Phyllobates talamancae (Cope).—One from El Valle, Middle Falls, R.P. Many were seen around small pools, along the stream.

Phyllobates flotator Dunn.—Five from Barro Colorado Island, C.Z. These active little frogs could always be found on the stream banks below the main laboratory.

SAURIA

Gonotodes fuscus Hallowell.—Four from Corozal, C.Z., and four from Old Panamá, R.P., in the shade under buildings, in abandoned shacks, on shady tree trunks, in piles of debris, and on old rock walls, these active geckos could be found in abundance. However carefully I caught them, their delicate skins would almost always tear.

Basiliscus basiliscus (Linnaeus).—One from Albrook Field, C.Z. This lizard was common along the small forested streams, the shaded rocky areas being their favorite habitat. When approached they run a few feet up the bank, stop, bob their head vigorously. As one draws a bead with a gun the lizard runs a few feet more and bobs again, always with one eye cocked on the intruder. The young are much more prone to dash across a stream and disappear in the undergrowth.

Iguana iguana iguana (Linnaeus).—Two from Corozal, C.Z. The so-called "Panamanian chickens" are still very abundant throughout the zone in spite of the hunted lives they lead. Hardly a day passed when I did not see a native with two or three large iguanas over his shoulder destined for the dinner table. Along the road they sell for seventy-five cents and in the market for one or two dollars. At times I would come upon them lying in the road in a stupefied condition and no problem to catch, but upon release in a cool house they quickly regained their nervous temperament and lashed violently with their tails when one approached within range. The natives catch them by clubbing them out of trees and running them down.

Anolis frenatus Cope.—Two from Barro Colorado Island, C.Z. Both were caught on tree trunks back of the main laboratory.

Anolis limifrons (Cope).—Two from Barro Colorado Island, C.Z., and one from Corozal, C.Z. Common around houses and old rock walls.

Anolis tropidogaster Hallowell.—One from Old Panamá, R.P. Found with *Anolis limifrons*.

Anolis lionotus Cope.—One from El Valle, Middle Falls, R.P. This specimen eluded capture by scampering across water back and forth between three rocks, 2 feet from each other. It has a large dewlap that reaches the posterior interfemoral region.

Norops auratus (Daudin).—Three from Corozal, C. Z. These long tailed anolis-like lizards are common around buildings and rubbish piles. Their tails seem quite firm even when roughly handled.

Ameiva leptophrys (Cope).—One from Corozal, C.Z. The habitat of this lizard was commonly in open areas, beneath large trees, close to human habitations. It would be most active in midday, foraging in the vicinity of its burrow. Upon being approached it would make a hasty retreat to its burrow, soon to reappear and forage some more.

SERPENTES

Liotyphlops albirostris (Peters).—One from Old Panamá, R.P., and one from Albrook Field, C.Z.

Constrictor constrictor imperator (Daudin).—One from Aguadulce, R.P., and another from Albrook Field, C.Z. The specimen from Albrook Field was heavily infested with *Amblyoma dissimile* Koch (1844).

Erythrolamprus bizona Jan.—One from Aguadulce, R.P.

Imantodes gemmistratus (Cope).—One from Aguadulce, R.P.

Thalerophis occidentalis (Günther).—One from Aguadulce, R.P.

Leptodeira rhombifera Günther.—One from Old Panamá, R.P. Scale rows 21, male, ventrals 175, caudals 78, anal divided, supralabials 8, infralabials 11, nasal entire, loreal present, preocular 1, postocular 2, subocular absent, temporals 1-1, body blotches 41, tail rings 26.

One from Sabanita, R.P. (Atlantic side of trans-isthmus highway). Scale rows 23, female, ventrals 172, caudals 72, anal divided, supralabials 8, infralabials 10, nasal entire, loreal present, preocular 1, postocular 2, subocular absent, temporals 1-2, body blotches 41, tail rings 26.

Oxybelis aeneus aeneus (Wagler).—One from Aguadulce, R.P.

Phimophis guianense (Troschel).—One from Aguadulce, R.P.

Pseustes poecilonotus shropshirei (Barbour and Amaral).—One from Barro Colorado Island, C.Z.

Stenorhina degenhardtii (Berthold).—One from Sabanita, R.P.

Xenodon rabdocephalus (Wied).—One from Aguadulce, R.P. Scale rows 19, ventrals 144, caudals 49, anal entire, supralabials 8, infralabials 11, nasal divided, loreal present, preocular 1, postocular 2, subocular absent, temporal 1-2, body blotches 13, tail rings 3, 12 maxillary teeth, 2 enlarged posterior teeth. A second specimen (body discarded) from the same locality had scale rows 19, supralabials 8, infralabials 10, nasal divided, loreal present, preocular 1, postocular 2, subocular absent, temporals 2-2, 13 maxillary teeth, 2 enlarged posterior teeth.

Micrurus dissoleucus dunni Barbour.—One from Aguadulce, R.P. Scale rows 14, male, ventrals 185, caudals 23, anal divided, supralabials 7, infralabials 6, nasal single, loreal present, preocular 1, postocular 2, subocular absent, temporals 1-1, body rings 11 triads, tail rings 4 triads, total length 27 mm., sharp tail.

Micrurus nigrocinctus nigrocinctus (Girard).—One from Aguadulce, R.P. Scale rows 15-15-15, anal divided, supralabials 7, infralabials 6, nasal single, loreal present, preocular 1, postocular 2, subocular absent, temporal 1-1-1, body rings 19, tail rings 3, nuchal black band 4 deep dorsally, 4½ deep ventrally.

Micrurus stewarti Barbour and Armaral.—One from Sabanita, R.P. Scale rows 15-15-15, male, ventrals 208, caudals 52, anal paired, supralabials 8, infralabials 7, nasal entire, two times as wide as deep, loreal absent, preocular 1, (black), postocular 2 (white), subocular absent, temporal 1-1, body rings 15 black, tail rings 3 black, tail length 7 mm., total length 48 mm. (2nd, 3rd, 4th subcaudals undivided), black rings three times the

width of yellow rings, average 9 ventrals in width; yellow rings average 3 ventrals in width, all scales are black tipped.

Bothrops lansbergi (Schlegel).—One from Aguadulce, R.P.

Lachesis muta Cope.—One from Madden Dam, C.Z.

Testudinata

Geoemyda annulata (Gray).—One from Barro Colorado Island, C.Z. A young specimen with a yellow dorsal stripe and fairly flat carapace. Two ticks (male *Amblyoma humerli* Koch) were attached between the marginal plates. Stepped on while going up steep path behind the main laboratory.

Chelonia mydas (Linnaeus).—One caught at Rio Hato, R.P. While collecting fishes at this beach resort, the natives pulled in an 85-pound turtle, which they promptly threw out of the net saying it was "malo." There were barnacles attached both top and bottom, which fell off after two months in fresh water. The turtle remained healthy in a large cement tank at the Corozal Bakery, until eaten.

Loricata

Caiman fuscus (Cope).—One from Pedro Miguel, C.Z. Most specimens seen did not exceed 3 feet in length. Many are used in the local leather trade, particularly by the tannery in Old Panamá. In captivity they maintain an aggressive attitude, hissing and snapping.

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Food and Growth of Two Species of Watersnakes from Western New York

By Edward C. Raney and Robert M. Roecker

LITTLE information on food habits based on the examination of stomach contents is available for the queen snake, *Natrix septemvittata* (Say). The few scattered data indicate crayfish are the most important food, a fact fully substantiated by this study. The common water snake, *Natrix sipedon sipedon* (Linnaeus), eats mostly fishes and amphibians, and smaller amounts of insects and mammals. This study is concerned with the food habits of the two species taken in the same habitat.

Habitat and Habits

Some 83 *septemvittata* and 96 *sipedon* were collected in Buffalo Creek and a tributary stream, Cayuga Creek, near the towns of Elma and Town Line, Erie County, in western New York, from June 2–5 and September 19–23, 1942, and on May 10, 1946. These creeks are shallow, meandering streams of alternating pools and riffles with gravel and rubble bottoms. The width varied from 30 to 55 feet and the riffles averaged a foot in depth while some pools were 6 feet deep. Small willows lined the mud banks and some emergent aquatic plants were present along the shallows near shore. Most snakes were captured under flat stones near the edge of the stream both in and out of the water. Queen snakes were observed foraging among stones and detritus in shallow, relatively fast moving water, or were lying motionless in quiet pools with only the head protruding. In contrast to the bottom foraging *septemvittata,* the common water snake was observed actively chasing and capturing fishes. Both feed in the same area but *septemvittata* more often forages under rocks. We have also observed *sipedon* feeding on small dead fishes lying along the shore of Chautauqua Lake, New York. Adult queen snakes are somewhat gregarious and on a number of occasions up to four individuals were found under one rock together with one or more *sipedon.* Both species often lie in the sun on overhanging logs and branches. There appears to be a tendency for queen snakes of the same size to stay together. When captured our specimens never attempted to bite even though roughly handled. In contrast the *sipedon* were always savage. They flattened the head and body and struck repeatedly. Both gave off foul smelling secretions.

Food

The snakes were killed shortly after capture, measured, and preserved in formalin. They were opened and the stomachs emptied of all food. The various items were sorted and identified to species wherever possible. The volumetric displacement of each food item was obtained and the percentages of total volume of food were calculated on this basis. The results are summarized in Table I. A striking difference in food is apparent; *septemvittata*

feeds almost entirely on crayfish, *sipedon* on fishes (95.8 per cent by volume) and frog tadpoles (4.2 per cent). The only other organisms present in 45 stomachs of the former were two dragonfly larvae. Despite its small mouth the queen snake often catches and eats very large crayfish. Most of the fishes eaten by *sipedon* were species that commonly dwell on or near the bottom. By volume suckers were most important and occupied 39.9 per cent, compared with 29.0 per cent for minnows. However, minnows were found in more stomachs. Most of those that ate fishes had only one specimen in their stomachs. One game fish, the northern smallmouth bass, *Micropterus dolomieu dolomieu,* occurs in both streams but was not found in any snake. Tadpoles were found in 9 *sipedon* stomachs. They are preferred by the smaller snakes and 7 of those engulfing tadpoles were 14 inches or less in length. The tadpoles were mostly small *Rana pipiens pipiens.* One 19-inch male had eaten 12 *Rana pipiens* tadpoles and a female the same length contained a large *Rana clamitans* tadpole.

TABLE I

FOOD OF TWO WATERSNAKES FROM WESTERN NEW YORK. BASED ON 59 STOMACHS OF *Natrix s. sipedon* THAT YILEDED 231.3 CC. OF FOOD AND 45 STOMACHS OF *Natrix septemvittata* THAT GAVE A TOTAL OF 119.3 CC. OF FOOD.

Natrix sipedon sipedon Food Item	Number of stomachs in which item was found	Percentage of stomachs in which item was found	Percentage of total volume of food
Fishes	53	89.8	95.8
Suckers, Castostomidae	9	15.3	39.9
Hog sucker, *Hypentelium nigricans*	4	6.8	17.4
Redhorse, *Moxostoma*	1	1.7	15.6
Common sucker, *Catostomus c. commersonnii*	4	6.8	6.9
Minnows, Cyprinidae	13	22.0	29.0
Shiners, *Notropis*	6	10.2	15.7
Creek chub, *Semotilus a. atromaculatus*	1	1.7	5.4
Bluntnose minnow, *Hyborhynchus notatus*	2	3.4	3.2
Blacknose dace, *Rhinichthys a. atratulus*	1	1.7	0.7
Cyprinid remains	3	5.1	4.0
Catfish, Ameiuridae; Stonecat, *Noturus flavus*	2	3.4	3.7
Mudminnows, Umbridae; *Umbra limi*	2	3.4	2.7
Darters, Percidae	8	13.6	5.3
Rainbow darter, *Poecilichthys caeruleus*	3	5.1	3.0
Fantail darter, *Catonotus f. flabellaris*	3	5.1	1.4
Johnny darter, *Boleosoma n. nigrum*	2	3.4	0.9
Fish remains	21	35.6	15.2
Frogs; tadpoles, *Rana pipiens* and *R. clamitans*	9	15.3	4.2
Natrix septemvittata			
Crayfish, *Cambarus*	44	97.8	99.4
Insects, dragonfly larvae	2	4.4	0.6

Other investigators have found crayfish in *septemvittata* but very few

stomachs have been examined. Out of 15 specimens from Pennsylvania, Surface (1906: 151) found 4 stomachs with crayfish and one with a toad. Conant (1938: 81) found that Ohio *septemvittata* disgorged crayfish and small fish when captured. Schmidt and Davis (1941: 213) mention that it is a selective feeder that subsists almost entirely on crayfish. Lagler and Lagler (1944: 301) reported one Michigan record of the queen snake eating crayfish.

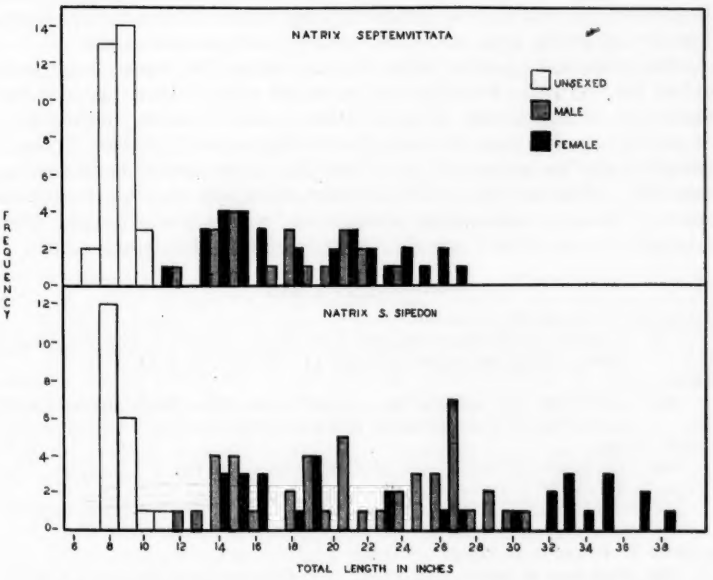

Fig. 1. Length frequencies of specimens of *Natrix septemvittata* and *Natrix sipedon* from Erie County, New York, collected on June 2–5, September 19–23, 1942, and May 10, 1946.

Our results with respect to the food of *sipedon* are similar to those obtained by other workers who have found that this species eats mostly fishes and amphibians, with a few mammals and insects. Surface (1906: 156) found the following in an unstated number of stomachs: fish, 11; amphibians, 9; mammals, 3; undetermined vertebrates, 2; and insects, 7. Uhler, Cottam and Clarke (1939: 614) found 96 per cent by volume to be cold-blooded vertebrates; fishes 61 per cent and amphibians 35 per cent. About 2.5 per cent was insect food. Brown (1941: 240) found about 80 per cent fish and 20 per cent amphibians in 210 stomachs from northern Michigan and central New York. Minnows, darters, cottids, and suckers were predominant. Conant (1938: 86) found mostly fishes and amphibians in their stomachs but also records crayfish and young *sipedon* as having been eaten.

Growth

The length frequency distribution of all the watersnakes collected is given in Figure 1. Juvenile *sipedon* in their first autumn of life and those taken early the following spring are mostly 8 to 10 inches long. Specimens one year older are commonly 14 to 16 inches in total length. These results are in line with those obtained by Blanchard and Finster (1933: 347) from marked living specimens in northern Michigan. They found that immature specimens have an annual growth increment of about 50 per cent. New York *sipedon* may grow slightly faster. Although several frequency peaks may be observed in our data on older *sipedon* it is impossible to define the age groups. Females apparently grow faster and reach a greater maximum size.

The queen snake grows at about the same rate as the common water snake during the first year. Seventeen specimens, all recently born, taken in September 19–23, ranged from 7.7 to 9.1 inches, mean 8.6 inches. In early June, 15 juvenile *sipedon* were from 8 to 10.5 inches, mean 9.2 inches. Those 21 specimens that are presumed to be a year older range from 12 to 16.6 inches, mean 15.3. Hereafter the growth rate decreases in both sexes but the females appear to have a greater annual increment and reach a greater length. These assumptions need to be checked by a study of marked living specimens.

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Tirodon, a Neglected Nominal Genus of American Cyprinid Fishes [1]

By Carl L. Hubbs

In 1882 (p. 68) Oliver Perry Hay described *Tirodon*, new genus, and *T. amnigenus*, new species, on the basis of a single young minnow from Pearl River at Jackson, Mississippi. He differentiated the genus and species from *Hybognathus argyritis* (= *H. nuchalis nuchalis*) on the basis of the biserial pharyngeal teeth. In 1887 (p. 251) he wrote: "It is not at all unlikely that the genus *Tirodon* (Hay, Bull. U. S. Fish Com. 1882, 68) was founded on a specimen of this same species with an abnormal number of teeth."

Since 1887 *Tirodon amnigenus* has dropped almost entirely out of the sight of ichthyologists. It was not mentioned, even as a synonym, by Jordan and Evermann (1896–1900), nor by Jordan, Evermann and Clark (1930), nor in any of the recent manuals. Fowler (1945: 25) listed it from the Pearl River basin, as *Tirodon amnigenus*, without comment.

The problem of the identification of *Tirodon amnigenus* is of considerable significance. In the first place it is desirable to place each proposed name either as a valid designation or as a synonym. Two statements in the original description—"mouth rather more oblique than in *Hybognathus argyritis*" and "eye contained in the head 3 times, equal to the snout"—would, if valid, indicate that *Tirodon amnigenus* may be identical with *H. hayi* Jordan (1885), over which it has priority. It is also possible, though inherently improbable, that *Tirodon amnigenus* is a valid genus and species, known only from the original account. In the second place it might be suspected from the original description and even from the specific name "*amnigenus*" that *Tirodon* was based on one of the numerous hybrids between genera of American cyprinids. Finally, if *Tirodon* was based on a species of *Hybognathus* an unexpected variation in dentition would be suggested.

In an effort to settle these questions the unique type of *Tirodon amnigenus* (No. 32157) was examined at the United States National Museum in May, 1933. It is a young fish, only 26 mm. in standard length, and in rather poor condition. It was found to agree with the young of *Hybognathus nuchalis nuchalis* Agassiz (the subspecies of *H. nuchalis* were treated by Hubbs and Lagler, 1941: 50). As viewed from the side the weakly upcurved mandible is very thin, but is provided with a definite symphyseal knob. The intestine is of small caliber and is considerably convoluted, though it is broken and therefore is not of determinable length. In every detail of proportions, physiognomy, fin position, scale size, etc., the type corresponds with the young of *H. n. nuchalis*. The reputedly greater obliquity of the mouth is attributable to the condition of the specimen, for, as is often true, the muzzle was obviously punched in during preservation. Nor is the eye as large as was indicated by Hay. Instead of entering the head about 3.0 times, as it does in the oblique-mouthed young of *H. hayi*, the eye measures about 4.0 times in the head (to the end of the opercular membrane), as it does in the young of *H. n. nuchalis*.

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1 Contributions from the Scripps Institution of Oceanography, New Series, No. 317.

Unfortunately it was not possible to verify the stated pharyngeal tooth formula (2, 4—4, 2), for both lower pharyngeals had been removed. Since in all other respects the identity with *H. n. nuchalis* seems assured, it is concluded that the dentition was either misinterpreted (it is difficult to remove intact the arches and teeth of a 26-mm. minnow), or was highly aberrant. The former alternative is favored, for it is not to be expected that the outer row of teeth is ever developed in *Hybognathus*. In American minnows with such dentition the teeth of the main row are so broad as to leave no room for a second row to develop. In this genus and in other herbivorous genera with like teeth, hundreds of dentitions have been examined without discovering one that is biserial.

It is concluded that:

(1) *Tirodon amnigenus* Hay is a synonym of *Hybognathus nuchalis nuchalis* Agassiz.

(2) The name *Hybognathus hayi* Jordan therefore retains validity.

(3) There is no good reason to suspect that *Tirodon amnigenus* was based on an interspecific hybrid.

(4) It is equally improbable that *Tirodon amnigenus* is a distinct genus and species known only from the unique type.

(5) It is more plausible that the dentition of the type was misinterpreted than that it really was biserial. This idea apparently cannot be tested, since the pharyngeal arches and teeth have become lost.

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Vertebral Counts and the Problem of Races in the Atlantic Shad

By Herbert E. Warfel and Yngve H. Olsen

Introduction

THE determination of intraspecific races among clupeoid fishes is an important problem that has long challenged fisheries workers. Many workers have attempted such determinations in the past on the basis of various meristic characters; but although a number of characters have been shown to vary, the number of vertebrae has been used more consistently than any other and is the most generally accepted criterion (cf. Runnström, 1941: 5).

Investigators working on the shad [*Alosa sapidissima* (Wilson)] from the Connecticut River are confronted with the same general problem. Are the fish of that stream distinct from those of other streams of the North Atlantic seaboard, and, if so, can the differences be revealed by vertebral counts? These notes are published with two thoughts in mind: (1) to make such data as are here presented available to other workers, and (2) to point out some difficulties that have arisen.

Vladykov and Wallace (1937) studied collections of shad from three separate localities on the western coast of the North Atlantic from the viewpoint of this general problem. Their samples were from the Schubenacadie River in Nova Scotia and from the Delaware and Chesapeake bays. In addition to analyzing data that they themselves collected, they compared their results with those previously reported by Leim (1924) from the Schubenacadie River, as well as from Scotsman Bay in Nova Scotia. On the basis of such meristic features as the number of vertebrae, pectoral fin rays and ventral scutes, Vladykov and Wallace indicated that there were significantly distinct races of shad between the Nova Scotia areas and the Chesapeake Bay. These latter differences, they maintained, were somewhat substantiated by such factors as the composition of the spawning population and by differences in the length of the fish.

Recently the Bingham Oceanographic Laboratory,[1] in co-operation with the Connecticut State Board of Fisheries and Game, assembled data on the vertebrae of shad that entered the Connecticut River in 1945 and 1946 as one phase of a larger program of research on the species.

Materials and Methods

Eight samples of shad taken in 1945 and 1946 from the Connecticut River were examined. These totaled 826 specimens (not including a number of atypical fish), and were taken at intervals throughout the period when the fish ascend the river, which in Connecticut is from early April to mid-June. The samples were collected by commercial fishermen using haul seines, gill nets and traps. In 1945 two of the samples came from the mouth of the Connecticut River at Cornfield Point and three from about 20 miles upstream at Haddam and Higganum, Connecticut. The 1946 shad were collected about

1 The authors wish to acknowledge the assistance of Daniel Merriman, Director, and the staff of the Bingham Oceanographic Laboratory, who helped with the laboratory work on this project, as well as Russell P. Hunter, Superintendent, Douglas Moss and Maurice Alexander of the Connecticut State Board of Fisheries and Game, for making the material available and for generous aid both in the field and laboratory.

3 miles upstream near Old Saybrook, Connecticut; but only three samples were available, all from the latter part of the "run" in that year (Table I). All samples were random for the gear used, except that of June 7, 1945, which was a market sample from which the smaller fish and many of the males had been discarded by the fishermen. Variations in sample size were, for the most part, due to the exigencies of fishing.

TABLE I

FIELD DATA ON SHAD FROM THE CONNECTICUT RIVER, 1945 AND 1946

DATE	LOCALITY	GEAR	COLL.
April 25, 1945	Cornfield Pt., Old Saybrook, Conn.	Trap net	Random
May 17, 1945	Cornfield Pt., Old Saybrook, Conn.	Trap net	Random
June 7, 1945	Conn. River, Haddam Island	Haul seine	Market
June 23, 1945	Conn. River, Higganum, Conn.	Gill net	Random
June 24, 1945	Conn. River, Higganum, Conn.	Gill net	Random
May 16, 1946	Conn. River, Old Saybrook, Conn.	Drift gill net	Random
June 3, 1946	Conn. River, Old Saybrook, Conn.	Drift gill net	Random
June 12, 1946	Conn. River, Old Saybrook, Conn.	Drift gill net	Random

The vertebrae were counted *in situ* by removing one side of the fish in order to expose the entire column. Except for the first sample, all counts were made by one person (Y.H.O.). Specimens in which the vertebrae were fused or otherwise atypical were discarded; all counts included the urostyle (Fig. 1).

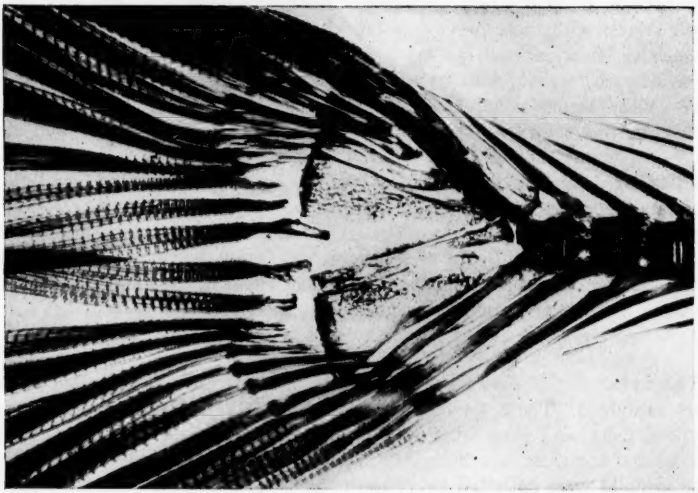

Fig. 1. Skeleton of caudal fin, stained by Alizarin Red S after the method of Cumley, Crow and Griffen (1939), showing the urostylar vertebra included in the vertebral counts.

CONNECTICUT RIVER DATA

The five samples that comprised the 1945 data totaled 452 fish, not including the discarded specimens. The distribution of the vertebral numbers

is shown in Table II, together with the mean values for each sample and the standard error of the mean (σ_M). The range of vertebral numbers for these 1945 Connecticut River shad was from 54 to 59, which is the same as that of the fish from Delaware Bay reported by Vladykov and Wallace (1937). The mean for the entire 1945 collection was 57.042 ± 0.0363. There was some difference between means of the samples in the 1945 collection, the greatest variation occurring between the samples taken April 25 and June 7, although the difference between these, 0.322, was not significant (d/σ_d=.135) when tested by conventional methods. Since all other differences between the sample means were of lesser magnitude, and since the samples were numerically larger with one exception, the 1945 population could be said to be homogeneous on this basis.

TABLE II

THE DISTRIBUTION AND MEAN VALUES OF THE VERTEBRAE OF CONNECTICUT RIVER SHAD FOR 1945

DATE	NUMBER OF VERTEBRAE						N	M	σ_M
1945	54	55	56	57	58	59			
April 25	2	1	10	35	7	—	55	56.800	±0.1102
May 17	—	2	21	88	35	1	147	57.082	±0.0557
June 7	—	4	23	53	40	3	123	57.122	±0.0768
June 23	1	0	18	48	21	1	89	57.045	±0.0810
June 24	—	2	4	23	9	—	38	57.026	±0.1206
TOTAL	3	9	76	247	112	5	452	57.042	±0.0363

TABLE III

THE DISTRIBUTION AND MEAN VALUES OF THE VERTEBRAE OF CONNECTICUT RIVER SHAD FOR 1946

DATE	NUMBER OF VERTEBRAE						N	M	σ_M
1946	54	55	56	57	58	59			
May 16	1	6	22	74	15	—	118	56.814	±0.0688
June 3	1	2	33	71	16	3	126	56.857	±0.0689
June 12	—	4	38	64	23	1	130	56.838	±0.0678
TOTAL	2	12	93	209	54	4	374	56.837	±0.0396

In 1946 three samples that totaled 374 specimens were studied, not including a few atypical fish that were discarded. As indicated in Table III, this was a fairly homogeneous lot, with a vertebral range identical to that of the previous year. The greatest difference between the means in 1946 was 0.043; the mean for the entire collection was 56.837 ± 0.0396.

When the yearly collections (the sum total of the 1945 samples vs. the 1946 samples) from the Connecticut River were compared by conventional statistical technique [2] the difference between the means of the years appeared to be significant (Table IV). The difference for those two years, 0.2 of a vertebra, was actually less than the difference between the two samples taken on April 25 and June 7 of 1945, but the values were weighted by the numbers of fish in both considerations. Thus, it would appear that differences

[2] The formulae are those of Simpson and Roe (1939: 154, 192–197). The formula chosen for the standard error of the difference between the means $\sigma_d = \sqrt{\frac{N_1}{N_2}\sigma^2_{M_1} + \frac{N_2}{N_1}\sigma^2_{M_2}}$ tests "whether the samples could come from populations with the same mean and variance."

as great as 0.2 approach the lower level of significance but can occur both between different years as well as between small samples in a given year.

Table IV also shows the comparative values of the means of each of the collections cited by Vladykov and Wallace [3] and those of the two Connecticut River collections for 1945 and 1946. The comparative values in this table are the differences between the means (d) and the d_M/σ_d. All of Vladykov and Wallace's data have been recalculated on this basis except for the small sample of 28 shad from the Chesapeake in 1936 which was disregarded because it was so small.

When the Connecticut River shad were compared with the fish reported upon by Vladykov and Wallace, it was evident that small, noncritical sampling can be misleading. The fish from the southward (Chesapeake and Delaware bays) differed significantly in vertebral number from the Connecticut shad taken in 1945, but, when compared with the 1946 Connecticut shad the Chesapeake fish were almost identical, while the Delaware shad continued to be different. When Connecticut shad were compared with those to the northward, the fish from Scotsman Bay differed in both 1945 and 1946, but the shad from the Schubenacadie River differed significantly only in 1946. Further confusion is engendered when thought is given to differences within more narrow geographical limits. For example, if the pronounced distinction between the Scotsman Bay and Schubenacadie River shad, when compared with the Connecticut River fish in 1946, is valid it would be interesting since they cannot be shown to differ between themselves (Table IV). Leim (1924), who studied the shad in both areas in Nova Scotia, considered that he was dealing with the same population.

Discussion

Thus, the extent to which distinctions can be established at this time between the shad in the various streams along the North Atlantic on the basis of vertebral number alone is not clear. A difference as small as 0.2 between the fish that enter the Connecticut River in different years is shown to be significant, but a difference of greater magnitude was encountered between two of the samples in the 1945 collection. It is apparent, then, that some of the samples under consideration in 1945 were too small to form an adequate basis for intra-annular distinctions; but on the other hand, the 1945 and 1946 collections are of sufficient size to indicate a definite difference between the vertebral numbers of the shad taken in those years. The comparisons between the shad in the rivers cited by Vladykov and Wallace are similarly open to question on the basis of sample size; and furthermore, a collection of a single sample might possibly be misleading since sample variations of equal magnitude may occur.

Another serious objection arises in connection with such comparisons as are outlined in Table IV. The danger inherent in comparing vertebral counts from shad collected from different streams in different years is obviously great.

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[3] The paper by Vladykov and Wallace contained two errors. (1) In Table 7, second row, "*Schubenacadie River." the total number of fish was 64 rather than 65, and the mean number of vertebræ was 57.23 ± 0.0954 rather than 57.22 ± 0.0940. This error was corrected by those authors in reprints they distributed subsequently. (2) In the last line of the same table, "Chesapeake Bay, 1937," seven specimens were listed as possessing 54 vertebrae. This makes the total number of fish too high by six. If this number is made to read "1" rather than "7," the total number will then read as they give it and the other values, mean and standard error, will check. Undoubtedly this latter was a typographical error.

Table IV

The Difference of Means and the Values of d_M/σ_d for the Various Areas, and Years in the Same Areas When Known

	CONN. 1945		CONN. 1946		CHESAPEAKE BAY		DELAWARE BAY		SCOTSMAN BAY		SCHUBENACADIE 1924		SCHUBENACADIE 1936	
			d	d/σ_d	d	d/σ_d	d	d/σ_d	d	d/σ_d	d	d/σ_d	d	d/σ_d
Conn. River, 1945	—	—	0.205	3.8*	0.236	3.21*	0.876	9.63*	0.364	4.79*	0.166	1.63	0.106	1.14
Conn. River, 1946	—	—	—	—	0.027	0.36	0.670	7.10*	0.57	7.84*	0.39	3.71*	0.33	3.46*
Chesapeake Bay, 1937	—	—	—	—	—	—	0.64	5.57*	0.60	4.88*	0.42	3.78*	0.64	6.27*
Delaware Bay	—	—	—	—	—	—	—	—	1.24	9.60*	1.02	7.02*	1.00	6.37*
Scotsman Bay, Nova Scotia	—	—	—	—	—	—	—	—	—	—	0.18	1.35	0.24	1.89
Schubenacadie River, Nova Scotia, 1924	—	—	—	—	—	—	—	—	—	—	—	—	0.06	0.48
Schubenacadie River, Nova Scotia, 1936	—	—	—	—	—	—	—	—	—	—	—	—	—	—

* Significant.

If a difference of significant magnitude can occur in the fish of one stream in two successive years, then it would follow that the only certain way to make valid comparisons between the fish of different streams would be to study large samples collected in the same year. Further precautions demand that subsamples be well distributed through the season of the spawning ascent. In connection with the difficulties of interpreting vertebral counts, it is of interest to note that Tester (1937), in his study of *Clupea pallasii* in British Columbian waters, showed that ". . . the mean vertebral count of a year class increases with age; that the larger individuals of a year class have a higher vertebral count; . . ." Thus, despite the suggestions contained in the data in Table IV, it is doubtful that they can contribute much to an understanding of the racial composition of the shad population.

It is not the intent of this paper to discuss the causes involved in these differences. The extent to which the differences are hereditary or ecological is a fine distinction which can be determined only by experimentation. Even were they hereditary to a degree, there still seems to be adequate reason to suspect that the different counts are influenced by differences in various environmental factors as pointed out long ago by other investigators, particularly Hubbs (1922, *et seq.*). In the search for causes, direct comparison of ecological data with vertebral counts would be complicated by the fact that each spawning run of shad may be composed of a series of different year-classes. If one year-group should happen to dominate the population for a number of years, as can happen with clupeoids, the ecological factors governing meristic counts for that year could conceivably be reflected in the vertebral counts over a considerable period. Under those circumstances, direct comparisons of such data as temperature with vertebral numbers would be questionable, if not impossible, without reference to age-grouping. The above arguments, as well as those of Vladykov and Wallace, are predicated upon the assumption that the shad is a "homing" fish, returning each year to the parent stream to spawn, but there always exists the possibility that the differences that arise between years in the same stream are due to spawning fish entering one stream that have originated or been developed elsewhere.

Hence, the affinities of the Connecticut River shad are not clear. Superfically, it would appear, on the basis of vertebral numbers alone, that the 1945 collection was more nearly related to the population from the northward, while the 1946 collection was very close to those from the Chesapeake. But the solution of the race problem will have to take into consideration larger samples of shad than have hitherto been studied, and vertebral numbers alone, in the absence of other data, are not sufficiently distinct to form the basis for racial discrimination, if, indeed, such distinction exists.

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The Effect of Asphyxia upon the Red Cell Content of Trout Blood

By ARTHUR M. PHILLIPS, JR.[1]

INTRODUCTION

THE amount of available oxygen has a noticeable effect upon the red cell content of the blood of air breathing animals. This is shown by the increased erythrocyte content of the blood of human beings during asphyxia and the increase in the number of red cells of persons residing at higher altitudes. Hall *et al* (1926) reported that during asphyxia the menhaden showed an increase of from 1,988,000 red cells per cubic millimeter of blood to 3,598,000 in a period of 50 minutes. Bonnet (1929) has shown similar results in his studies upon some of the lower vertebrates. With these studies in mind a series of experiments were made upon the effect of asphyxia upon the erythrocyte count of the blood of brook trout.

METHOD

Brook trout (*Salvelinus fontinalis*) were held in unaerated aquaria containing 10 liters of water. Eighteen trout of from 3 to 4 inches in length were placed in the aquaria and at intervals of one half hour for the first two hours and hourly from two to four hours, fish were removed, the water

[1] The Fish and Wildlife Service, United States Department of the Interior.

analyzed for oxygen and carbon dioxide and blood counts were made upon the trout. Three fish were used for each time interval and the experiment was repeated six times. Duplicate counts were made upon each fish.

The data have been summarized in Table I. The values shown in this table are the average of all observations. The significance of the differences has been judged by means of an analysis of variance.

TABLE I

THE EFFECT OF A DECREASE IN OXYGEN AND AN INCREASE IN CARBON DIOXIDE UPON THE RED CELL CONTENT OF THE BLOOD OF BROOK TROUT HELD IN AQUARIA WITHOUT AERATION

Time in hours	Red cells per cubic millimeter of blood[1]	Rise in red cells per cubic millimeter of blood[1]	Per cent rise in red cells per cubic millimeter of blood	Oxygen in parts per million	Fall in oxygen, per cent	Carbon dioxide in parts per million	Per cent rise in carbon dioxide
0.0	1,090	—	—	10.2	—	0.9	—
0.5	1,214	124	11.4	5.2	49.0	2.2	144.0
1.0	1,278	186	17.2	3.0	70.6	3.4	277.0
1.5	1,303	213	19.6	2.4	76.4	4.5	400.0
2.0	1,290	200	18.4	2.0	80.4	5.3	488.0
3.0	1,289	199	18.3	1.8	82.3	5.8	544.0
4.0	1,302	212	19.4	1.7	83.3	6.3	600.0

1 Expressed in thousands.

DISCUSSION

The blood count of the trout rose rapidly for the first hour after the fish were placed in the aquarium and then tended to remain constant for the duration of the experiment. At the same time the oxygen showed a marked decrease with the passage of time, falling from a high of 10.2 parts per million at the start to a low of 1.7 parts per million at the end of four hours. The carbon dioxide content of the water increased from 0.9 parts per million to 6.3 parts for the same time intervals. The results are graphically shown in Figure 1.

The difference between the control fish and the count at one half hour and the difference between the half-hour count and that made at one hour are highly significant. The other values in the table are not significantly different from each other.

It is concluded that the fish was able to meet the increased demand in oxygen carrying capacity of the blood for the first hour. After this, even though the oxygen content of the water continued to drop, the trout's body was no longer able to increase its erythrocyte count beyond the initial rise.

These experiments are preliminary in nature, but there is a strong possibility that the blood count of trout will vary in nature with the oxygen content of the water. If such is the case a knowledge of the effect of oxygen and carbon dioxide of the water upon the erythrocyte content of the blood of trout will be necessary. This is especially true in the early diagnosis of anemia in hatchery-reared trout. One series of experiments at the Cortland, New York Station, has shown that in a series of ponds the last pond in the series

with an oxygen content of 5.2 parts per million, held fish with a blood count 11.5 per cent higher than the first pond in the series with an oxygen content of 10 parts per million.

The results obtained in these experiments agree closely with a similar series of experiments upon blueback salmon made during the spring of 1944 (Phillips, unpublished data).

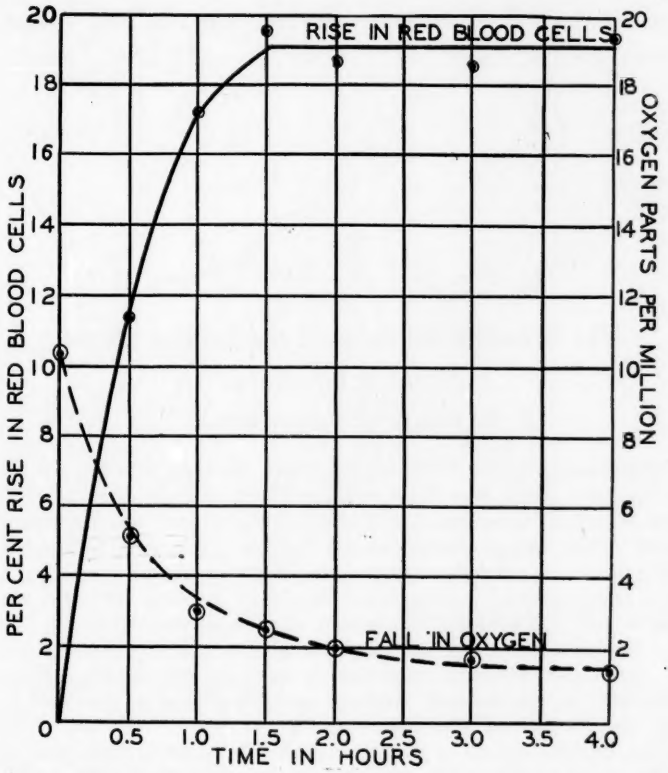

Fig. 1. Relationship between rise in red blood cells of trout and fall in oxygen during asphyxia.

Conclusions

1. Brook trout showed a marked increase in the red cell content of their blood during the first hour of asphyxia.
2. After the first hour, a further decline of oxygen in the water and an increase in carbon dioxide did not cause a further increase in the number of erythrocytes.
3. The effect of the gases of the water (oxygen and carbon dioxide) may be an important factor in the early diagnosis of anemia in hatchery-reared trout.

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The Breeding Behavior of the Bridled Shiner, *Notropis bifrenatus*[1]

By ROBERT W. HARRINGTON, JR.

THE breeding habits of the bridled shiner, *Notropis bifrenatus* (Cope), blackchin shiner, *Notropis heterodon* (Cope), and blacknose shiner, *Notropis heterolepis heterolepis* Eigenmann and Eigenmann, have not been described. Their ranges overlap, notably in New York state, although the bridled shiner is a strictly eastern form (Fig. 1), whereas the other two species range westward into the upper Mississippi drainage. All prefer quiet, weedy waters, and none of them exceeds three inches in total length. They are so similar in appearance that they have been confused in the earlier literature. Their chief economic importance is as forage fish, especially, due to their small size, for the early stages of such game fishes as the pike, *Esox lucius*, and the pickerel, *Esox niger*.

The following account of the breeding behavior of the bridled shiner may provide a clue to that of the other two species. The observations recorded here were made at the Oyster River in Durham, New Hampshire, on 60 days in 1946, from mid-February to mid-July, and on 33 days in 1942, from late June to mid-August.

The bridled shiner seldom exceeds 2 inches in total length (Adams and Hankinson, 1928: 343). The largest one on record was 48 mm. in standard length or $2\frac{7}{16}$ inches in total length (Bailey, 1938: 169). The largest one encountered by the author was 45 mm. in standard length. The following dates have been published as the breeding times for this species: May 2 to August for Ithaca, New York (Wright and Allen, 1913), mid-May to mid-

1 Abstracted from a doctoral dissertation prepared under the direction of Professors A. H. Wright and E. C. Raney of Cornell University.

June for Oneida Lake, New York (Adams and Hankinson, 1928: 269), during June and part of July for Connecticut (Webster, 1941: 160), and May and June for Pennsylvania (Fowler, 1909b: 531). Fowler (1909a: 365)

Fig. 1. The geographic distribution of *Notropis bifrenatus*. Plotted from specimens examined and from literature records which are considered reliable. The apparent absence of the species from eastern Massachusetts and Rhode Island is undoubtedly due to an absence of collectors in these areas.

mentions "an unusually yellow example" collected in the Delaware River in New Jersey on July 11, 1908, but he apparently failed to recognize this as breeding coloration for he states elsewhere (1909b: 531) "the sexes are colored alike, although during the breeding season in May and June, the gravid females are deeper bodied." Greeley and Greene (1931: Pl. VI) figure

a male in breeding coloration collected in Tibbit's Creek in the St. Lawrence watershed of New York on July 7, 1930, and Webster (*loc. cit.*) refers to the "bright yellow below the lateral band" in ripe males.

Sexual Dimorphism

During the spawning season, adult males and females differ in coloration. Males become light yellow to bright yellow-gold along the sides below the characteristic black lateral band from behind the operculum to the caudal fin. The color is in part yellow concentrated along myotomes and scale margins and in part a metallic golden sheen reflecting from the exposed surfaces of scales. The area of most intense color is that located just below the lateral band and which in uncolored specimens gives silver reflections. It is bright yellow with metallic gold reflections. Below this, the yellow alone extends a short distance, soon giving way to the usual dirty white of the belly. The rays of the dorsal, caudal, and to a slight extent, of the anal fin are a faint yellow. Ripe females also develop this fin-ray color, but otherwise they resemble non-breeding males except for their deeper bodies and slightly more protrusive anal papillae. Three other differences, more apparent in the field, exist at this time. Breeding males are somewhat darker dorsally than breeding females, as the brown edging of their scales has become heavier. The first five or six pectoral rays are more heavily margined with brown than in females or non-breeding males. Lastly, there is a functional dimorphism in size, males generally courting females larger than themselves, although an occasional male pursues females of size equal to or smaller than himself.

A male $1\frac{11}{16}$ inches in total length and in breeding coloration is figured in full color by Greeley and Greene (1931: Pl. VI). This fine representation is typical of a male with breeding color not fully developed. In life, the colors are brighter, the dorsum is darker with a more evident criss-cross pattern due to the dark edging of the scales, and the anterior rays of the pectorals are more heavily bordered with brown.

At Durham, New Hampshire, in 1946, the first traces of breeding color were noted on April 22. Many males were brightly colored by the end of May, and from the first week of June into the first week of July, the majority of adult males were so colored. In 1942, some highly colored males were seen as late as the last week of July, though after this date, more and more males were without color or were imperfectly colored. A few were observed as late as August 5 with some breeding color.

Breeding coloration developed in males as small as 24 mm. in standard length ($1\frac{1}{4}$ inches total length). Females as small as 30 mm. in standard length ($1\frac{1}{2}$ inches total length) acquired fin-ray color.

Spawning Period

Breeding activity was observed on twenty-one different days in the backwater of the Oyster River at Durham, New Hampshire, between May 22 and July 13, 1946. Fluctuations in the intensity, frequency and extent of activity occurred, but they showed no obvious correlation with environmental factors. On three days in May, five days in June, and three days in July other than those just alluded to, no signs of breeding were noted. Before June 7, nothing

construed as actual spawning was observed; sexual activity appeared to be limited to courtship and brief nuptial chases. Thereafter, activity was more violent and consistent. The period of greatest intensity extended from June 17 to June 25. After June 30, only an occasional brief pursuit, nosing, or tentative investigation of a female by a male was seen; the last of such behavior was recorded on July 13.

Spawning began as early as 4:30 A.M., before the sun had appeared over the horizon. There was no definite height of activity. It was strongest between 7:00 A.M. and 2:00 P.M., but became negligible between 3:00 and 4:00 P.M.

Breeding activities were observed at water temperatures ranging from 58° F. to 80° F. During the entire period, only between May 30 and June 4 did daytime water temperatures fall below 60° F. and then only to 57° F. The average minimum, mean and maximum water temperatures recorded when breeding was being observed were 63° F., 69° F., and 71° F., respectively.

Spawning Site

The typical breeding site was located from 3 to 10 yards from the bank, in still water about 2 feet deep. Here the emergent vegetation was interrupted to leave an area of free surface water, 10 to 15 feet square, over a bottom of silt and detritus covered by a dense, often pure carpet of water milfoil, *Myriophyllum.* (Once a pure stand of stonewort, *Chara,* was utilized.) There were 6 to 18 inches of free water above this submerged vegetation, permitting unobstructed movement and vision. Such niches were located within wide expanses of yellow water lilies, *Nuphar advena,* and pickerel weed, *Pontederia cordata,* interspersed with such other plants as hornwort, *Ceratophyllum demersum,* pondweeds, *Potamogeton,* duckweed, *Lemna trisulca,* and bladderwort, *Utricularia.* These weed beds filled the shallow bays and lagoons of the narrow half-mile long Oyster River backwater, in which there was no perceptible flow and which was sheltered by high banks thickly wooded to the water's edge. Without a canoe or boat breeding would have been overlooked. Almost exactly coincident with the height of the breeding season, the surrounding conifers cast their pollen, rendering opaque the surface of the water which was already obscured by brown color and frequent high turbidity. As activity slackened toward the end of the breeding season, the more typical breeding sites were gradually abandoned, and some breeding behavior was observed in rather nondescript regions lately invaded by vegetation. Some of these were relatively barren, and all of them permitted freedom of movement.

Breeding Behavior

The first indications that the breeding season had begun (May 22) were several pursuits, casual and brief, of large females by smaller males. The participants soon resumed feeding with the other members of the school, which had shown no interest. A day later, a male was seen to dart after a female of his own size and to nudge her several times from beneath. On May 31, three large pale females remained a long time almost motionless near the surface, their only movement being slow strokes of the tip of the tail. A male, smaller and darker, approached one of them from behind and nosed her the length of the ventral side. Later, one nosed her ventrally while another nosed

her snout. During the entire procedure, the female did not alter her position, and finally moved away leisurely and resumed feeding. On subsequent days, motionless females were nosed also, ventrally by a male on either side or ventrally up one side and down the other by a single male. These females invariably swam off slowly and resumed feeding. Occasionally one male drove off another.

On June 7, a greater restlessness was apparent among adults, with less feeding and more swimming about and at higher levels. Swift sustained pursuits of females by males became the prominent element of the behavior pattern, the more so as individuals of this species usually swim with neither speed nor direction and had never been seen to move so rapidly. All breeding behavior took place within an inch or two of the surface, but the surface was never broken. These conditions held throughout the season.

During the last three weeks of June variations in activity were mainly quantitative. From one to three males, seldom more, pursued a single female, usually all but two, occasionally all but one dropped out. A male was seen to dart at and drive off a third, and one female was pursued by three males, now one and now another taking up the chase. One male started a female, and after the two attained a certain speed, other males, frequently of larger size, either joined or displaced the first. Some males forsook the female originally followed for another encountered along the way, and complicated interplays took place, one such involving two females and five males in a restricted area. Pursuits lasted from one second to almost a minute and covered as much as three yards. In an area of open water 6 yards square, as few as one female and four males and as many as six females with attendant males carried on simultaneously. Frequently, the chase was broken off early, and it appeared that on some of these occasions the male had found the female either immature or otherwise unprepared to spawn. Males prodded females in the region of the anal papilla and often the snout of the male was kept appressed to this region as the two swam along, but as the tempo of the pursuits increased, it was difficult to make out such particulars. Sometimes the female would slow down, the male following with a zig-zag motion and nosing her when she stopped; one such female was nosed by three males in succession, the last starting her again, but soon giving up the chase. Infrequently, a male was seen circling beneath a motionless female.

As the season progressed an increased number of pursuits were accelerated to the maximum speed exhibited by this species. Details of the culminations of such rapid chases, which usually ended in a slight curve with the female closely flanked by two, or sometimes only one male, and which were broken off abruptly, could not be made out. Therefore, it cannot be stated positively that spawning had taken place, although no other action as intense or as likely was ever observed, and from specimens collected during this period (June 18 and June 19) fertile eggs were obtained by stripping. Whether the particulars of so brief a climax could be made out by the unaided eye, even under favorable conditions of visibility, is doubtful.

In breeding areas, males predominated and were very active; females were rather passive unless pursued. At the height of activity, males were seen chasing other males, small yearling chubsuckers (*Erimyzon o. oblongus*), and once a small golden shiner (*Notemigonus c. crysoleucas*). These, the

only other species found over the breeding sites, were present infrequently and were not observed to feed on the eggs. No regularity could be discovered in the duration of alternate periods of activity and quiescence, and it was found necessary to remain at one location for some time before concluding that breeding was or was not going on.

Within a few feet of such breeding areas, where other individuals foraged for hours at a time, no breeding was ever observed. In the breeding area itself, during intervals of inactivity, both male and female bridled shiners were seen feeding, or resting near the surface. No holding of territory, combat, or ushering of females into breeding areas was observed. A clue as to how females came into such areas is furnished by the following episode. A female in an area adjacent to that in which breeding was in progress, was seen to swim about in a restless manner, unusual in the sex. She drove off some smaller females which had ventured near her, and later, attracted by the activity nearby, swam over that way, and was soon engaged by males.

Males evidently spawn many times in one day, judging from their continuing though sporadic activity at the same location. To what extent a male spawns on successive days was not apparent as the recognition of individuals of so small a species is difficult. A female peculiarly parasitized was engaged more than a few times in one day and was seen over the breeding area on more than one day.

Eggs and Young

The number of eggs deposited at one spawning was not determined, though it is most likely quite small. Eggs must sink about a foot through the open water before reaching the thick weed cover below. The *Myriophyllum* and bottom silt over which spawning took place were searched carefully but the eggs, which probably fall to the bottom like those of the silvery minnow (Raney, 1939: 687), could not be found. The artificial mingling of eggs and milt in dishes yielded fertile eggs, which hatched in 57 hours at a mean temperature of 75° F. The eggs are demersal and, although adhesive at first, become non-adhesive later. After swelling they have an outer diameter of 1.5 mm.

The first young were discovered within the interstices of the *Myriophyllum* cover, where they hung motionless, half-concealed by the leaves. They were first sighted in 1942 on July 4, and in 1946 on July 2. Their presence was restricted to those limited areas where spawning had taken place, and within which they were thinly scattered, singly or in twos and threes. Those collected on July 2, 1946, ranged from 6 to 11.5 mm. in total length or from approximately 5 to 9 mm. in standard length. Specimens hatched and reared in the laboratory attained sizes comparable to this minimum and maximum in one and three weeks, respectively. Very small fry of the following other species were taken in collections of young bridled shiners on July 2 and 5: *Notemigonus c. crysoleucas, Erimyzon o. oblongus, Hololepis f. fusiformis* and *Lepomis gibbosus*.

The young of *Notropis bifrenatus* are a very pale straw color when viewed from above, and are easily distinguished from those of the golden shiner (*Notemigonus c. crysoleucas*), which are heavily pigmented with black dorsally and look dark gray in the water, and from those of the chubsucker (*Erimyzon o. oblongus*), which have two dark longitudinal dorsal lines sepa-

rated by a light median line, this combination being most prominent on the head. Only one young darter (*Hololepis f. fusiformis*) was collected and no others were seen. Young of the bridled shiner and of the common sunfish (*Lepomis gibbosus*) were easily confused in the water in their early stages; their color was about the same, and they differed only in the imperceptibly more bulging lines and broader heads of the sunfish. However, sunfish fry were gregarious and bridled shiner fry were solitary at this stage. At later stages, only bridled shiner fry retained their extreme paleness and were readily distinguished from all the other species mentioned.

At first the young of the bridled shiner remained down among the *Myriophyllum,* from which they had only partially emerged. By July 9, 1942, although the young were becoming conspicuous in widely separated areas, they were still mostly in twos and threes, whereas golden shiners and sunfish fry were found in schools of as many as fifty individuals. By the fifteenth, young bridled shiners were swimming in open water and over barren bottoms, and were of general distribution in the shallows. By July 23, they were occasionally found associated with adult bridled shiners, which they appeared to outnumber. No school of more than sixteen individuals was encountered before July 31, when an entire school of young which was collected, was found to number 128 individuals. By the first week of August, small groups of mixed young and adults were common. Young collected on August 18 ranged from 11 to 22 mm. in standard length.

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Ichthyological Notes

PRESENCE OF OÖGONIA AND OÖCYTES IN SPAWNED PACIFIC SALMON.[1] —It has been questioned whether or not all the germ-cells mature for the single spawning of the Pacific salmon. In the *Journal of Morphology* (73, 1943: 207–229) I described the histological changes in the testes of the sockeye salmon (*Oncorhynchus nerka*) before, during and after the spawning and presented comparable data for the rainbow trout (*Salmo gairdnerii*). In the salmon as well as in the trout all the reproductive cells do not mature. After the fish have spawned, there remain resting spermatogonia which in the trout can form spermatozoa for the next spawning season.

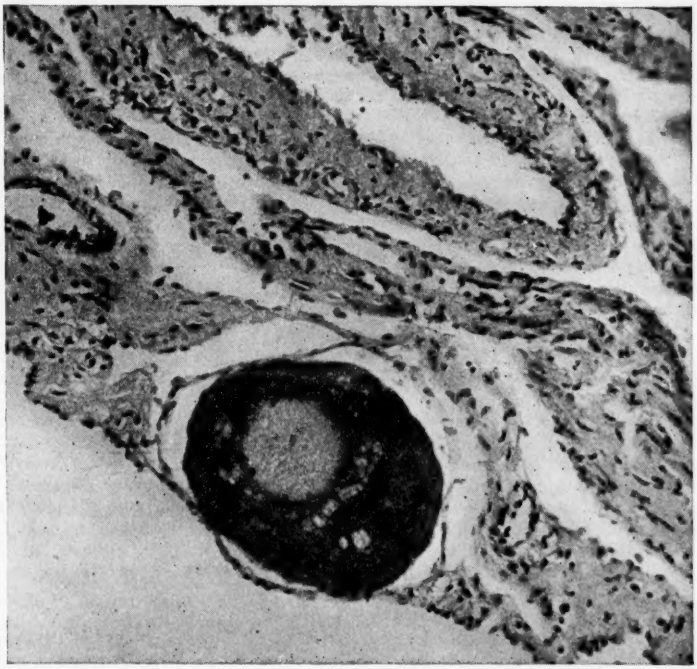

Fig. 1. Photomicrograph of a section of ovary from a post-spawning sockeye salmon. An oöcyte 180 μ in diameter lies near the bottom of the field.

When the material for this study was gathered, a series of ovaries was also collected. This material was obtained from sockeye salmon which had been planted in Flathead Lake, Montana. They formed a landlocked race in that lake. These fish arrive on the spawning grounds along the gravel shores in sound condition. Soon after spawning they exhibit signs of decay and they die.

Sections of ovaries from salmon which had completed spawning have from 1 to 20 oöcytes in each cross section (Fig. 1). The oöcytes are not atretic. They range in size

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[1] Contributions from Scripps Institution of Oceanography, New Series No. 317. Acknowledgment is due Dr. C. L. Hubbs for criticism of the paper.

from 90μ to 195μ. It is even more significant that there are in the stroma numerous cells that are characterized by a large spherical nucleus, with thread-like chromatin radiating from the large nucleoli. These appear to be typical definitive germ-cells, in every way similar to oögonia in sections of immature salmon and trout ovaries. Ovaries from salmon which had spawned a few days previously are pycnotic—an indication of the general decay which sets in before death.

The factor that limits the spawning of this Pacific salmon to a single season is not the potential supply of germ-cells. Were it to survive after spawning, enough germ-cells remain to replete the ovaries for another season.—GEORGE F. WEISEL, *Scripps Institution of Oceanography, University of California, La Jolla, California.*

PLATYSOMATOS, A NEGLECTED NAME FOR A GENUS OF ASPREDINID CATFISHES.—M. E. Bloch in 1794 (Naturgeschichte der Ausländischen Fische, 8: 52) and again in 1797 (Ichtyologie ou Histoire Naturelle, Generale et Particuliere, de Poissons, part 11, 42–52) described the new genus *Platystacus.* In this genus he placed four new species, *P. cotylephorus, P. laevis, P. anguillaris,* and *P. verrucosus,* without designating a genotype. Apparently, it was not until Bleeker (1862, Atlas Ichthyologique des Indies Orientales Néêrlandaises, 2: 19) designated the type of *Platystacus* as *P. cotylephorus* Bloch that the genotype was established.

Possibly for an etymological reason, Bloch changed this generic name in the *Additions aux douze tomes de cet ouvrage* (1797, Ichtyologie, v. 12: 115) and proposed the name *Platysomatos* to be substituted for *Platystacus.* As *Platystacus* was a valid *nomen novum, Platysomatos* must be considered as a substitute name, and, as such, takes the same genotype. It is, therefore, an absolute synonym of *Platystacus.*

Platysomatos has been omitted by all nomenclators. It will, of course, not come into use unless and until *Platystacus* becomes unavailable for some reason.—ROBERT R. HARRY, *Natural History Museum, Stanford University, California.*

LAMNA DITROPIS, NEW SPECIES, THE SALMON SHARK OF THE NORTH PACIFIC.[1]—A study of the "salmon shark" or "mackerel shark" of the North Pacific Ocean shows it to be a species of *Lamna* quite distinct from *L. nasus* (Bonnaterre) of the North Atlantic. It also appears to be separable from the species of the Southern Hemisphere. Unlike *Isurus,* from which it differs in the structure of the denticles and of the vertebral centra, as well as in the hitherto used character of the teeth, *Lamna* is a member of the pantemperate fauna, avoiding the tropics. We have in preparation a paper discussing these generic and distributional relationships, along with a detailed description and figures of the new species. This diagnosis is published now to make the name available for mention by Bigelow and Schroeder, in their treatment of the elasmobranchs in the forthcoming first volume of the *Fishes of the Western North Atlantic.*

Lamna ***ditropis,*** new species

HOLOTYPE.—An adult male collected in 300–350 feet of water 3.5 miles off the Beach Club at La Jolla, California, by Art Coles and Edgar E. Rock on December 7, 1945. Field No. H45-211. Cat. No. 36471, Museum of Comparative Zoology.

RANGE.—Coastal waters of the North Pacific, from San Diego, California, through the Pacific Northwest and Alaska to Japan. Generally in deeper waters southward.

DIAGNOSIS.—Like *Lamna nasus* in most respects, differing most conspicuously in having the lower parts coarsely blotched with blackish in the adult and in having the snout broader and relatively shorter, particularly in the preoral length.

The often-copied figure of *Lamna cornubica* that appeared in Jordan and Evermann's *Fishes of North and Middle America* (Bull. U. S. Nat. Mus., 47 (4), 1900: 3232, pl. 6, fig. 22), was based on a young specimen of *Lamna ditropis* from Santa Cruz (not "Santa Barbara"), California. This specimen, Cat. No. 27368, U. S. National Museum, is designated as a paratype.—CARL L. HUBBS and W. I. FOLLETT, *Scripps Institution of Oceanography, University of California, La Jolla, California,* and *California Academy of Sciences, San Francisco, California.*

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1 Contributions from the Scripps Institution of Oceanography, New Series, No. 331.

TWO DEVICES TO FACILITATE THE TAGGING OF FISH IN THE FIELD.—Any apparatus facilitating field work is obviously of advantage, particularly when it is necessary to work alone on commercial fishing boats. The idea for the following devices has undoubtedly occurred to many persons. However, we have never seen descriptions of anything of a similar nature, and as they have proved so handy, it seems worthwhile to pass them along.

Using the celluloid disc type of tag was a slow process, chiefly because of the operation of placing each tag on its pin just before attaching the tag to the fish. We tried stringing a number of tags on their pins and sticking the pins, in numerical order, in a piece of soft wood placed conveniently at hand (Fig. 1). The pins and tags could then be picked up as needed, and the speed of tagging was greatly increased. Later, we began using a plywood board to which had been glued a sheet of pressed cork. The board measures 17⅛ by 11⅛ inches, and is large enough to hold about 250 tags. The cork surface is much more satisfactory than wood in that it holds the tags more firmly and does not splinter.

Fig. 1. Tagging equipment used on a small fishing boat. Tag board and notebook at left of camp stool.

The second device which we have used successfully is a sheet of acetate plastic as a temporary record sheet. This material, roughened on one side, replaces paper in the field notebook. Its great advantage is that it can be written upon with pencil even when covered with salt water. At the end of the day, notes are transferred to permanent records and the acetate sheet cleaned with an eraser.—JAMES E. MORROW, JR., *Osborn Zoological and Bingham Oceanographic Laboratories, Yale University, New Haven, Connecticut.*

PICKEREL AND PUMPKINSEED COACTION OVER THE SUNFISH NEST.—During observations on the spawning of the pumpkinseed *Lepomis gibbosus* (Linnaeus), made at Lincoln Pond, on the Edmund Niles Huyck Preserve, near Rensselaerville, New York, in early July, 1945, a chain pickerel, *Esox niger* LeSueur, on several occasions shared the nest with the male sunfish. After the female sunfish had spawned in each nest, swarms of golden shiners, *Notemigonus crysoleucas* (Mitchill), approached to eat the eggs. The male sunfish always drove away some of the shiners but many more came in while the male was away. At this time the pickerel, lying in the nest or very near it in the vegetation, usually darted in, attacking or carrying away a shiner and causing the other shiners to retreat. When on one occasion the pickerel was snared from the nest, the number of shiners taking eggs greatly increased.

Near the same spot on June 26, 1946, two 6-inch pickerel were seen to dart from

a sunfish nest as I approached at 12:15 P.M. In the nest a male sunfish of about 5½ inches and a female of about 4 inches were seen in the characteristic spawning behavior. The male remained upright but the female kept tipping up, pushing her vent against his. This lasted for about one minute. Golden shiners became so numerous in the nest that the male sunfish chased after them. The female remained in the nest until the male returned and then left. One 6-inch pickerel came back to the nest, lying 1 to 2 feet from the male sunfish. Another female sunfish came to the nest at 12:35 P.M. and as the two sunfish circled the nest rapidly, the pickerel left. The male sunfish appeared to be eating his own eggs or picking up something else off the bottom. The 6-inch pickerel came back at 12:38 P.M. and at 12:41 grabbed at something in the water while remaining 2 or 3 feet from the nest. Two minutes later a 12-inch pickerel was seen over the nest, but a disturbance soon frightened it away. About 25 shiners were seen about the nest at 12:48 P.M. when a female sunfish came in and spawned for about 2 minutes. During this time an 8-inch pickerel was in the nest with the two sunfish and was seen to dart 6 times at shiners, keeping them all out of the nest. The female sunfish and 12-inch pickerel left the nest at 12:50 P.M. and the 6-inch pickerel returned. At 12:52 the 8-inch pickerel returned and the 6-inch pickerel left. At 12:54 the male sunfish chased out this pickerel. This was the only time when the sunfish was seen disturbing the pickerel. At 12:55 the same pickerel and male sunfish were resting peacefully in the nest again. At 12:58 a 12-inch pickerel moved in with the male sunfish, moving in circles around it, but not attacking. The 12-inch and 8-inch pickerel exchanged places in the nest several times before the female sunfish entered and started spawning at 1:05 P.M. The sunfish continued spawning with interruptions as the male made dashes at some of the 35 to 40 shiners which became too numerous in the nest. At 3:40 P.M. another nest was observed with a male sunfish guarding and a 14-inch pickerel in the nest with him. Many shiners circled the nest without entering.

Little is known of coactions benefiting both species, mutualistic coactions, as shown between the pickerel and sunfish. Hubbs and Cooper (1936, Cranbrook Inst. Sci., Bull. 8) quoting Hankinson (1920, Occ. Papers Mus. Zool. Univ. Mich. 89: 1–14), reported one such relationship between the horny-headed chub and common shiner on the gravel pile nest of the chub. The nest received the eggs from females of both species, "One male of each species often occupied the nest simultaneously, neither paying any attention to the presence of the other, but driving away any other fish approaching the nest." Activities of the common shiners were restricted to protection of the nest while the male horny-head transported pebbles to it as well as acting as a guard. Reighard (1942, Papers Mich. Acad. Sci., Arts, Lett., 28: 397–423) described similar spawning interactions of the river chub, over its nest, with the common shiner, central stoneroller, and rosyface shiner.

It would be interesting to know whether more sunfish survive when there are pickerel present to keep the golden shiners in check. Raney (1942, Jour. Wildlife Management, 6: 58–66), studying the same pond, reported that fish occupied first place in percentage by volume of pickerel food. The two fish most frequently eaten, golden shiners and bullheads, were present in the pickerel stomachs in about the same percentage by volume. As pickerel food sunfish represent only about 3 per cent by volume contrasted to 28 per cent of golden shiners. It is not known whether or not a larger percentage of golden shiners would be found in pickerel stomachs during the spawning time of the sunfish.—HURST H. SHOEMAKER, *Department of Zoology, University of Illinois, Urbana, Illinois.*

RECORDS OF THE MOONEYE (*HIODON TERGISUS*) AND THE QUILLBACK SUCKER (*CARPIODES CYPRINUS*) FROM SASKATCHEWAN.—During the summer of 1946 experimental gill nets were operated in Pine Island or Cumberland Lake, Saskatchewan, situated at 54° N. Lat. and 102° 20′ W. Long., in connection with work carried on by the Fisheries Research Board of Canada. On August 5 the nets yielded six specimens of *H. tergisus* and one specimen of *C. cyprinus* in addition to other species. These appear to be additional records to the recognized fauna of Saskatchewan. Richardson (1836) recorded *H. tergisus* from this lake but the report has been ques-

tioned by later authors. The present specimens confirm this original record. Although *C. cyprinus* has been recorded from the Saskatchewan River drainage in Alberta and Manitoba this is the first record from Saskatchewan.—Wm. M. Sprules and K. H. Doan, *Central Fisheries Research Station, Winnipeg, Manitoba, Canada.*

DEVELOPMENT OF TEETH IN THE CALIFORNIA FISH *ATHERINOPS AFFINIS.*—The bifid teeth of the genus *Atherinops* form the chief character used to separate it from its nearest relative *Atherinopsis,* which has simple teeth. Both genera are found abundantly on the California coast. A study of the teeth in *Atherinops* shows that in immature fish the teeth do not exhibit the bifid character seen in the adult. Figure 1 shows representative lower teeth in a specimen 31.5 mm. in standard length from Tomales Bay.

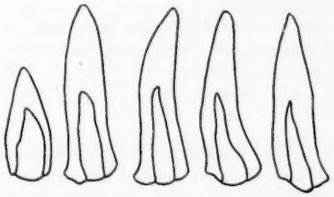

Fig. 1. Representative lower teeth of *A. a. affinis,* 31.5 mm., from Tomales Bay.

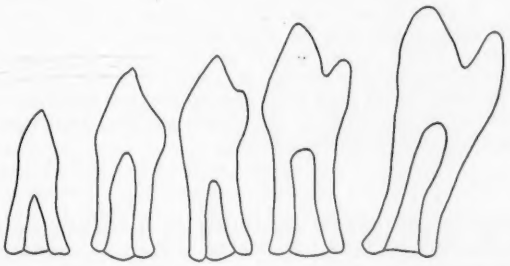

Fig. 2. Representative lower teeth of *A. a. affinis,* 39.6 mm., from Tomales Bay.

Two populations were used in this study: *Atherinops affinis affinis* (Ayres), collected at Tomales Bay, California; the other *Atherinops affinis littoralis* Hubbs, collected at Mission Bay, Crown Point, San Diego, California. The latter collection was furnished by Mr. Boyd Walker.

The lower jaw teeth begin to develop the bifid character in advance of the upper jaw, and the forking is initiated at a slightly smaller size in *A. a. littoralis.* Bifid development begins in the more median teeth and progresses laterally. This is indicated in Figure 2, showing representative teeth of the lower jaw from a specimen 39.6 mm. from Tomales Bay.

Due to the nature of the character it can be treated statistically only by comparing the sizes of the fishes when the teeth are not all bifid. Mortality will cause even these curves to be skewed to the left. For this reason standard deviations are not shown. The

table below summarizes the data on the specimens of the two series having part of the teeth bifid.

A. a. affinis	Range Length [1]	Mean Length	Number of Specimens
Upper Jaw	55–67 mm.	59.1	52
Lower Jaw	43–58 mm.	52.3	30
A. a. littoralis			
Upper Jaw	45–61 mm.	52.9	22
Lower Jaw	36–56 mm.	46.9	26

1 That is the range of sizes in which bifid teeth first appeared.

These data indicate that the southern population develops the bifid tooth character approximately 6 mm. in advance of the northern population, this apparently being a racial difference in developmental rate.

Thanks are due to Dr. Carl L. Hubbs for suggestions in this study.—GARTH I. MURPHY, *Bureau of Fish Conservation, California Division of Fish and Game, Stanford University, California.*

AN UNUSUAL SEX RATIO IN SWORDTAILS.—In a strain of blood-red swordtails, of unknown origin but in all respects except color resembling typical *Xiphophorus helleri,* an apparent preponderance of males was observed. In order to exclude the possibility of the result being caused by differential mortality, the following experiment was carried out.

A litter of 145 was placed in a concrete vault (7 ft. x 2⅓ ft. x 1⅓ ft.) on April 12, 1945, two days after they were born. As the young males became distinguishable by showing secondary sex characters they were counted and removed. Between June 22, 1945, and June 5, 1946, 95 males were removed, leaving 20 large females. This left 30 unsexed individuals unaccounted for, which presumably had died and were eaten.

Assuming the mortality to be equal in the two sexes, there would have been nearly five times as many males as females. It is still evident that the sex ratio is very abnormal, for assuming that all those dying were females there would have been nearly twice the number of males.—HURST H. SHOEMAKER and WILLIAM NIXON, *Depart. of Zoology, University of Illinois, Urbana, Illinois.*

THE SHORT-TAILED SHREW (*BLARINA*) AS A SOURCE OF FOOD FOR THE GREEN SUNFISH.—It is not surprising that certain small mammals, particularly those which are insectivorous, feeding along the edge of a stream or lake, might fall prey to certain large fish. Largemouth bass, for example, are known to prey occasionally upon moles and mice. It was somewhat surprising to us, though, to find such an insectivorous mammal as an adult short-tailed shrew, in the stomach of a 6¾-inch, 20-ounce green sunfish (*Lepomis cyanellus* Rafinesque). In addition to the remains of the short-tailed shrew, *Blarina brevicauda carolinensis* (Bachman), there was a crayfish, a large fly, and a beetle in the stomach. The adult shrew alone would weigh about 20 grams.

The stomach of this sunfish is one of 84 stomachs of *Lepomis cyanellus* collected during June, July, and August, 1946, from Lake Glendale, Shawnee National Park, in southern Illinois. No mammalian remains were discovered in the other 83 stomachs, nor in the 197 stomachs of largemouth bass, 245 stomachs of bluegill, or 17 stomachs of warmouth bass. Mammals were certainly not a common item in the diet of the fish of this lake and it can be surmised that this unfortunate shrew pursued an invertebrate too near the water.—MELVIN T. HUISH and DONALD F. HOFFMEISTER, *University of Illinois, Museum of Natural History, Urbana, Illinois.*

OBSERVATIONS ON THE BREEDING HABITS OF THE YELLOW PERCH, *PERCA FLAVESCENS* (MITCHILL).—The literature regarding the breeding habits of the perch has been reviewed by Adams and Hankinson (The ecology and economics of Oneida Lake fish, Bull. N. Y. State College of Forestry, I, 4a. Roosevelt Wild Life Ann., I, 3 and 4, 1928: 425–426) and Webster (Conn. Geol. and Nat. Hist. Surv. Bull. 63, III, 1941: 199). They describe the eggs, the habitats where eggs are found, and give dates and water temperatures for the spawning period. The statement that spawning takes place at night occurs in both publications, but Webster points out that no account of the actual breeding behavior has been published.

During the course of periodic observations at the Oyster River backwater in Durham, New Hampshire, between late February and mid-July, 1946, perch eggs were first discovered on April 14. Following unusually warm weather in March, when many aquatic vertebrates were in evidence, the first week of April was very cold, and no aquatic vertebrates were seen between March 29 and April 10. On April 14, the air temperature was 60° F. and the water temperature was 48° F. at noon. Egg strands of *Perca flavescens* were found hanging entwined in branches and tree tops of birch, *Betula populifolia*, which had been blown or had toppled into the water. These branches were in water 1-3 feet deep, and their small twigs were from 1-2 yards from the adjacent high bank. Egg strands were located at several points along the bank for a distance of 100 yards, but only among birch branches, and they were associated almost exclusively with the smaller twigs. Although no fish were seen, commotion was noted in the water a few yards offshore.

On April 16, the air temperature was 50° F. and the water temperature 48° F. at 9:40 A.M. Egg strands were found on more birch branches within the same length of shore line, and on others distributed along the bank for 200 yards. A few were lying over fresh pine boughs, *Pinus strobus*, recently blown down, and floating high. At one place, a birch had broken near its base, and lay with top branches in the water and trunk attached to the stump. The largest number of egg strands seen up to this date were interwoven in the twigs of its terminal branches, which projected about 2 feet down into water 3 to 4 feet deep. Many strands were close to the surface; others were among the lower twigs, and some were strewn beneath on the barren bottom, which was littered with pine needles and the leaves of deciduous trees. The water was very turbid, its surface was ruffled by gusts of wind, and visibility was further obstructed periodically by scudding clouds. However, between 50 and 100 adult perch were glimpsed, congregated about the birch and with more converging from the deeper waters. A single, large, conspicuously gravid female was followed by a long queue of males. The first two males kept their snouts prodded against the belly of the female, and they were followed by a double row of males so close to one another that the retinue moved as one body led by the female. Several such retinues were formed, and maneuvered in the area at the same time. Each one was about a yard long, and numbered from 15 to 25 individuals. These queues followed a curved course, ranging from the bottom in 2 to 4 feet of water, and often proceeding through spaces among the interlacing branches near the surface. At 11:30 A.M. in water at 49° F., activity continued, but fewer fish appeared to be present. Similar breeding sites were searched all along the bank, but activity was apparently restricted to this one place. Eggs taken into the laboratory at 1:45 P.M. had lozenge-shaped blastodiscs surmounting their animal poles. In one kept alive until 4:00 P.M., the blastoderm had almost reached the equator of the egg mass.

The Oyster River backwater is about 700 yards long, and extends almost due north and south. Except at its northern and southern extremities, it is not over 100 feet wide. Both banks are high and thickly wooded to the water's edge. The waters along the east bank are shaded during most of the morning. In this connection, it is noteworthy that, although spawning sites similar in all other respects to those described were available along the east bank, perch eggs were found only along the west bank, which receives the morning sun. On April 17, eggs were distributed from the southern end of the backwater for 400 yards, up to the inlet of the small Oyster River, which enters the backwater from the west. None were found north of here, toward the outlet. They were present only under the conditions noted above, and always where the bottom shelved

off into somewhat deeper water, and where no weed beds grew in, later in the season. They were found on the bottom only below branches in which others were entwined, never on water-logged branches, and only on the smaller twigs of fresh branches.

On April 17 at 9:40 A.M., the water temperature was 49° F. in the shade. Perch were seen in moderate numbers around the birch top referred to above, but no breeding activity was observed at this time. At noon, the water was 54° F. here, in the sun, and females and their retinues were again active, although visibility was so poor that further details could not be made out. The only other perch seen was a single individual sighted toward the southern end of the backwater. On April 21, no aggregations of perch were found anywhere; only a single individual was seen, up under the east bank in very shallow water. However, more eggs were discovered at the southern end of the backwater, and a few strands were present among some branches at the sunlit western bank of a bend in the Oyster River. After April 22, when one perch was seen at the northern end of the backwater in water at 58° F., neither adult nor young perch were ever seen, although observations were made periodically for the next two and one-half months.

In conclusion it should be mentioned that breeding activity could not be seen from the shore although it went on close to the bank. Observations were made from a canoe, often directly above the perch. The author steadied the canoe by holding on to the birch top referred to before, and even though the canoe was moved into several positions, perch within 2 feet of it continued their activities with no apparent concern. No other species were seen in the vicinity of the perch.—ROBERT W. HARRINGTON, JR., *35 Main St., Durham, New Hampshire.*

AN EARLY MENTION OF *ANABLEPS*.—Robert Harcourt, of Stanton Harcourt in the County of Oxford, Esquire, "in the year of our Lord 1608, and the 23 of March," having furnished himself "with one ship of fourscore tunnes, called the Rose; a Pinasse of six and thirty tunnes called the Patience and a shallop of nine tunnes called the Lilly," and having "prepared all things in readiness" embarked his company of "fourscore and seventeene," whereof threescore were landsmen, and set sail from the Range at Dartsmouth; the evening following they lost sight of the Lizard and faired away for the Canaries and the Coast of Guinea.

Here they took possession of "a goodly country, and spacious Empire, on the north part bounded with the sea, and the great river of Orenoque . . . on the east and south parts with the famous River of Amazones; and on the west part with the Mountains of Peru." Whereupon Robert Harcourt, Esquire, hied himself home to render an accounting of his stewardship to Prince Charles.

"Of fish," he said, "the varietie is great, first of Seafish, there is Sea-breame, mullet, Soale, Scate, Thornebacke, and Swordfish, Sturgeon, Seale, a fish like unto a Salmon, but as the Salmon is red, this is yellow; Shrimps, Lobsters and Oysters which hang upon the branches of trees."

Moreover, there was "a rare fish called Cassoorwa, which hath in each eye two sights, and as it swimmeth it beareth the lower sights within the water, and the other above; the ribs and back of this fish resemble those parts of a man, having the ribs round and the back flat, with a dent therein, as a man hath; it is somewhat bigger than a Smelt, but far exceeding it for daintie meat; and many other sorts there be most excellent."

As a description this may lack measurements and proportions, but there seems no reason to doubt that he meant *Anableps* of one species or another, there being, so far as I know, no other American fish having divided vision.

If this is correct, Harcourt's account (Purchas,[1] his pilgrimes, James MacLehose and Sons, Glasgow, 1906, xvi: 380), is one of the earliest references to this interesting genus. J. L. BAUGHMAN, *Marine Laboratory, Game, Fish and Oyster Commission, Rockport, Texas.*

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[1] The full title of Harcourt's narrative is "A relation of a voyage to Guiana." The first edition of Purchas is entitled "Purchas his Pilgrim. Microcosmvs, or the Historie of man. Relating the wonders of his generation, vanities in his degeneration, necessity of his regeneration. . . ." London, Printed by W. S. for H. Fetherstone. 1619., 14 p. l., 818 p., 16½ cm. This was followed by numerous others, climaxed, in modern times, by the MacLehose edition mentioned above.

NOTES ON THE DIET OF THE GOOSEFISH, *LOPHIUS AMERICANUS*.[1]—There is perhaps no fish along our North Atlantic coast that has a more voracious appetite or consumes a greater variety of food than the goosefish, or angler. It ranges along the coast of eastern North America from the Newfoundland Banks to North Carolina and, in deep water, still further southward. A specimen caught by the research vessel *Atlantis* on the south coast of Cuba has yet to be compared with *americanus*.

The diet of the goosefish includes many species of fishes such as eels, herrings, mackerel, cod, haddock, hakes, sculpins and flatfishes. Any fish it can catch doubtless finds its way into the capacious stomach. It also is known to have captured birds such as cormorants, loons and gulls as well as a long list of invertebrates, and Bigelow and Welsh (1924, U. S. Bureau of Fisheries, Bulletin, Pt. 1) state that "in short, nothing edible that strays within reach comes amiss."

Varied as is its diet, marine turtles have not as yet been included in the list of foods, hence it is of interest to report that, on June 10, 1944, Mr. Marcus Conlan found a goosefish on the shore of Nonamesset Island, off Woods Hole, Massachusetts, which had in its stomach a specimen of Kemp's turtle (*Lepidochelys kempi* Garman) that had a carapace 9¾ inches in length. It is evident that the turtle was much too large and indigestible for the goosefish and was the direct cause of its death.

Another instance of this sort came to my attention in 1925 during a cod tagging cruise of the U. S. Bureau of Fisheries Steamer *Halcyon*. On Nantucket Shoals we gaffed a slowly swimming *Lophius* which proved to be 3 feet long and had in its stomach a haddock 31 inches long, so large that it evidently prevented the goosefish from leaving the surface because of the gases produced during the slow process of digestion.

It is also of interest to note that this 31-inch haddock was of an extraordinary size, for of about 15,000 caught with hand lines during the cod investigation, from 1923 to 1932, between Cape Sable, Nova Scotia, and Nantucket Shoals, only about 100 exceeded 30½ inches in total length.—WILLIAM C. SCHROEDER, *Woods Hole Oceanographic Institution, Woods Hole, Massachusetts.*

1 Contribution No. 396 from Woods Hole Oceanographic Institution.

A NOTE ON THE CAPTURE OF SMALLMOUTH BASS BY ANGLING THROUGH THE ICE.[1]—Although the smallmouth bass (*Micropterus d. dolomieu*) is famed for its pugnacity when taken by angling during the warmer months of the year, many fisheries authorities have held the belief that during winter in northern latitudes the species "hibernates," or at least sinks into a state of profound lethargy where its instincts for feeding and combativeness are stilled. There have even been reports of specimens being brought up, by mechanical dredges, from resting places among rocks or in the mud bottoms of lakes during this season.

Within recent years rumors have reached the Michigan Institute for Fisheries Research of catches of smallmouth bass being made by ice fishermen on Elizabeth Lake, Oakland County, and elsewhere in the state. No substantiating facts were available until early March of 1946, when the writer, while supervising a winter lake mapping party on Walled Lake, Oakland County, chanced to observe that a nearby angler seemed to be catching and returning to the water a number of rather large fish. Closer inspection revealed the fish to be smallmouth bass, and two specimens, 10 and 12 inches in length, were obtained for the Institute's collection. This fisherman, and others on the lake interviewed later, were agreed that on certain days during the winter smallmouth would take the hook more readily than the yellow perch which were the anglers' objective; and it was further maintained by them that on Walled Lake the smallmouth bit more readily in winter than in summer.

The two identified specimens were taken on minnows (*Notropis atherinoides*) from water 15 to 20 feet deep, within 1 to 3 feet of the bottom, at a point about 400 feet off shore near the northeast end of the lake. Beneath the ice cover the water was clear, and the immediate bottom was composed of pulpy peat. Anglers on the lake also reported that smallmouth bass had been taken in large numbers through the ice from water of similar depths off the south shore, near the southwest end of the lake.—LELAND R. ANDERSON, *Michigan Department of Conservation, Watersweet, Michigan.*

1 Contribution from the Michigan Institute for Fisheries Research.

A FINE-SCALED SUCKER, *CATOSTOMUS*, FROM LAKE CUSHMAN, WASHINGTON STATE.[1]—More than a decade ago, Dr. Victor Scheffer turned over to me four specimens of a fine scaled *Catostomus* that he had collected in Lake Cushman, Olympic Peninsula of Washington. My intention has been to describe it as new. Such action has been delayed because before any new suckers are named in the group centering around *C. catostomus, C. griseus,* and *C. rostratus,* the entire genus should be revised on the basis of large series from numerous localities. In 1937 I started such a study, but other duties and interests have intervened. Therefore, this note is published with the hope that some ichthyological student will collect a large series of this fine-scaled sucker from the Olympics and determine its relationships.

My data indicate that the Olympic specimens are most closely related to *Catostomus catostomus griseus* of the upper Columbia River system in Idaho, Montana and Wyoming.

Probably this is another member of that ancient fish fauna that has been found to occur in western Washington, which is otherwise represented by *Novumbra hubbsi* Schultz and *Prosopium snyderi* Myers.

Lake Cushman, with an outlet flowing into the Skokomish River, thence into Hoods Canal, may be considered part of the Puget Sound drainage. These specimens are the first record of a fine-scaled *Catostomus* from that drainage system. The entire endemic freshwater fish fauna of the Puget Sound drainage and coastal streams of Washington north of the Columbia River are the same species or are closely related to similar species in the Columbia River, except *Novumbra.* Undoubtedly, if the streams and lakes of western Washington are carefully searched, other relics may be found as remarkable as the centrarchid, *Archoplites interruptus* (Girard) of the Sacramento River, the trout perch, *Columbia transmontana* Eigenmann and Eigenmann of the lower Columbia River, and *Novumbra hubbsi* Schultz of the Chehalis River.

The Lake Cushman specimens of *Catostomus* were measured and these data, expressed in thousandths of the standard length, are recorded in Table I.

TABLE I

MEASUREMENTS MADE ON THE FOUR SPECIMENS OF *Catostomus* FROM LAKE CUSHMAN, RECORDED IN THOUSANDTHS OF THE STANDARD LENGTH

Total length in mm.	224	231	220	223
Standard length in mm.	192	191	180	184
Length of head	240	250	240	250
Length of snout	110	110	105	115
Greatest depth of body	198	199	210	190
Tip of snout to dorsal origin	492	523	530	518
Tip of snout to pelvic insertion	575	560	557	533
Diameter of eye	42	42	40	38
Width of interorbital space	92	105	94	103
Greatest width of mouth	86	93	83	88
Length of caudal peduncle	155	178	178	168
Least depth of caudal peduncle	80	79	82	80

The following counts were made, respectively: Dorsal fin rays 10; 10; 10; 10. Anal 7; 7; 7; 7. Pectoral 19–21; 19–19; 17–18; 20–18. Pelvics 11; 11; 10; 11. Scales in lateral line 96; 98; 100; 99. Scales above lateral line 17; 18; 17; 18. Scales below lateral line 14; 13; 13; 15. Scales before dorsal fin 57; 50; 52; 52. Scales behind dorsal fin 40; 46; 41; 43. Total gill rakers on first arch 24; 23; 23; 22.

There is about one row of papillae under incision of lower lip. The peritoneum is silvery to light dusky with black pigment spots.—LEONARD P. SCHULTZ, *U.S. National Museum, Washington, D.C.*

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[1] Published with the permission of the Secretary of the Smithsonian Institution.

A NEW GENERIC NAME FOR A SYNENTOGNATHAN FISH FROM THE UPPER EOCENE OF CALIFORNIA, TO REPLACE *HEMIEXOCOETUS*, PREOCCUPIED.—*Hemiexocoetus* David, 1946 (Carnegie Inst. Wash. Publ. 551 (4): 59; genotype *Hemiexocoetus eocenicus*), is preoccupied by *Hemiexocoetus* Fowler, 1901 (Proc. Acad. Nat. Sci. Philad.: 293). Fowlers' species, *H. caudimaculatus*, was based on a juvenile of *Fodiator acutus pacificus* Brunn.

We propose ***Eoexocoetus*** (dawn flying fish) as a new name for *Hemiexocoetus*, which is to be suppressed, with the genotype *Eoexocoetus eocenicus*, the only species described up to date.

We might add here another comment. Fossil scales belonging to the Order Iniomi have repeatedly been found in California fossil deposits. In the paper on upper Cretaceous fish remains from the western border of the San Joaquim Valley (David, Carn. Instit. Wash. Publ. 551 (5): 101), the Iniomi have been referred to as a wholly bathyal group of fishes. The Synodontidae, which are Iniomi, should properly have been excluded from the statement, since synodontids are found commonly in coastal waters. However, the Synodontidae show very different scales from the rest of the Iniomi; these scales are easily distinguished. Synodontid scales are rare or absent in California fossil deposits. Only one scale (unpublished) has tentatively been referred to that family. Scales evidently belonging to bathyal members of the Iniomi are commonly found in fossil strata of various ages in California. Some of these have been described in the above mentioned papers (*Iniomus fossilis, Sardinioides californicus*). Two other undescribed genera may also be mentioned (see nos. 8 and 22; Carn. Instit. Wash., Publ. 551 (3): 30, 32). Myctophid scales are very abundant in some horizons of the California Tertiary (undescribed). We have to thank Dr. Carl L. Hubbs, Scripps Institution of Oceanography, for directing our attention to the above mentioned changes.—LORE ROSE DAVID, *California Institute of Technology, Pasadena, California.*

CONCERNING FISHES FALLING FROM THE SKY.—Years ago Gudger went through the literature and gathered material which led him to the conclusion that fishes sometimes fall from the sky. He published first in 1921 and later three more papers on this subject. Lately, Evans (April, 1946, Atlantic Monthly) expressed his doubt of these conclusions and following Gudger's (1946, Science, 103: 693–694) reply he extended his remarks (Evans, Science, 103: 713, 1946).

I have never read Gudger's papers on this subject and have had no particular interest in the matter because I came to the conclusion years ago that it was quite physically possible for fishes to be transported through the air by strong winds and that such happenings had probably taken place.

My mother once told me that about 50 years ago when she was a child a small object fell to the ground in the yard of her home in Bienville Parish, Louisiana, during a heavy rainstorm, and could be seen flopping about. She was standing on a porch at the time with her father, brothers and sisters. The children were somewhat excited and exclaimed, not knowing what the object was, but the father remarked calmly that it was a small fish carried by the wind and told the children to get it. They found that it was a small fish similar to those found in nearby creeks. Although it could have been carried by a bird, it is not the habit of birds to fish during stormy weather and heavy rains.

Mr. Ashbury Lore, an employee of the Shannon Feed Company of Tulsa, Oklahoma, recently told me of another instance. About 52 years ago he was riding horseback in company with a man named D. E. Ridenhour across a locality known as the Galloway Prairie in Oklahoma, in a heavy rainstorm. At about the time the rain came to a stop Ridenhour saw a fish flopping in a small depression in the ground, which had been filled with water. They dismounted and picked up a small, live "sun perch" about 3 or 4 inches long. The locality is approximately on the line between Osage and Marys counties close to where the town of Belle, Oklahoma, now stands. Little Spring Creek was 6 miles north and Dry Ford Creek was 6 miles south of the locality. The intervening area was dry prairie. When I suggested to Mr. Lore that possibly a bird carried the fish, he replied that, if so, the bird carried the fish "a long way in one of the heaviest rains I ever saw fall."

The U. S. Bureau of Fisheries, now Fish and Wildlife Service, had connected with it throughout its long history most of the leading ichthyologists of North America. Employees of this agency have not been free from error, but it was never the policy of this agency to adhere strongly to one side or the other of any highly controversial subject. Pertinent to the subject at hand is an undated mimeographed leaflet put out by the Bureau of Fisheries. It is numbered 1–120 and entitled, "Rains of Fishes, Toads, Frogs, Etc." I quote:

> Reports of rains of organic matter have been recorded in all parts of the world from ancient to very recent times and the truth of such phenomena is quite well established. Among the materials that have been observed falling from the sky are fishes, frogs, toads, birds, insects, earthworms, plants, etc. The U. S. Weather Bureau has collected and published many references to such occurrences in a paper by Waldo L. McAtee. This paper is out of print but it may be possible to consult it in libraries which receive Government publications. It is cited among the titles given at the end of this memorandum.
>
> Reports of toads and frogs falling in showers from the sky have come from various foreign countries, but the Weather Bureau has found no such occurrence reported for the United States. But for fishes, there are several reports one instance may be cited. In the Monthly Weather Review for June, 1901, p. 263, is the note that Mr. J. W. Gardner, voluntary observer at Tillers Ferry, S. C., reports that during a heavy local shower about June 27 (1901), there fell hundreds of little fish (cat, perch, trout, etc.) that were afterwards found swimming in the pools between the cotton rows.
>
> In the article referred to above Dr. McAtee writes substantially as follows: All strong winds have some lifting power, as is well known: when they begin to whirl their lifting and carrying capacity increases enormously. It has been recorded that at Beauregard, Miss., on April 22, 1883, the solid iron screw of a cotton press (weighing 675 pounds) was carried 900 feet by a tornado, and there are records of other heavy material having been transported great distances by the wind. Therefore, there seems to be no reason to doubt the accounts of organic showers. It is reported that waterspouts have emptied harbors and fish ponds to such an extent that the greater part of their bottoms were uncovered. Naturally, under such circumstances, fishes and other organisms in the water may change their habitat very abruptly.

The peculiar and odd things done by heavy winds range from the humorous to the tragic. My experience with hurricanes has shown that sheets and large drops of salt water can be carried by the wind. There is little doubt that small fishes could also be carried. Since they are quite common near shore it is probable that they are sometimes transported overland by this means.

The morning paper, which I picked up after these lines were started, carried this Associated Press story, dated June 17, 1946, about a tornado near Detroit:

> The rolling, devastating wind ripped into River Rouge, six miles from downtown Detroit and then smashed across the Detroit River into Sandwich, on the outskirts of Windsor, Ont.
>
> Water spouts were raised on the Detroit River as the tornado zoomed to the Canadian side, ... Spectators told of freight cars tossed about like playthings, houses lifted from their foundations and even bodies being carried away by wind.

If fish were at all common in the Detroit River where the tornado struck, it seems more probable than not that some of them were blown about by the wind. Doubtless they could easily have gone unnoticed at the time.

Possibly, reports of fishes carried by high winds would be more common than they are, if inclement weather and poor visibility did not make such observations difficult, and if potential observers did not have their attention distracted by concern for their personal safety or that of their families and property at the time and place where such occurrences are most likely to take place.

I have never seen fish fall from the sky and have little expectation of doing so. Nevertheless, I hold with Dr. Gudger that it is possible and that fishes do fall from the sky at times.

Of more practical interest to biologists than the transportation of fishes by winds, is the mode of distribution and dispersion of fishes into new and relatively impermanent ponds made by heavy rains. In Louisiana and south Texas I have observed fishes in ponds a few days after the ponds were formed. Little is known about how quickly such introduction takes place, but whatever the mode of dispersion it must be relatively fast and the carrying capacity must be relatively large. Buchanan (Nov. 23–30, 1911, Nature), the chemist of the Challenger Expedition, reported that in France such fishes came up from the mud where they had secreted themselves during the previous droughts, and according to H. M. Smith (1945, U. S. Nat. Mus., Bull. No. 188) this is the explanation of the quick reappearance of fishes in the fresh waters of Siam after heavy rains following dry spells. I seriously doubt that this explanation holds true for south Texas, while at the same time transportation by birds and winds seem not to have the carrying capacity or dependability to account for the numbers of fishes seen. This is an interesting field for investigation.—GORDON GUNTER, *Marine Laboratory, University of Miami, Coral Gables, Florida.*

Herpetological Notes

SNAKE SKINS AND COLOR.—In going over old records and specimens of snakes taken at Kartabo, British Guiana, many years ago, I came across a forgotten box of snake skins collected from twenty to twenty-five years back. The flat skins were attached tightly to cardboard, and although quite without preservative through the years, showed no signs of moth or beetle injury. The colors were as brilliant as in life. I had forgotten the exact technique, as I had the box of specimens, so, on my 1945 and 1946 expeditions to Venezuela, I began to experiment, and offer the following suggestions.

Kill the snake, if possible, by drowning, and immediately record all regular data, measurements, weight, colors of skin and eyes, etc. Within two or three hours after death, skin it by a straight mid-ventral incision from neck to tail tip. Cut around the side of the head to the gape, so when the entire skull and jaws are free, the dorsal and ventral cephalic scales are left intact.

Have ready a sheet of moderately stiff cardboard. I use our regular water-color paper, three-ply, Strathmore Board, matt surface, measuring 11½ by 14½ inches.

Starting with the head, the skin is gently spread and pressed down evenly and firmly, working back slowly. At the bottom of the sheet it may be necessary to cut straight across the skin and begin again at the top. It is easier for two people to work together, one advancing with all eight finger-tips consolidating the contact, especially along the edges, while the other person spreads, flattens and presses down. When the entire skin has been attached to the paper, it is placed upon any firm, flat surface, as a table, or the floor, covered with a sheet of blotting paper, on top of which come newspapers or more cardboard, and finally heavy weights, such as books. The blotting paper should be changed at least twice in two days, when the process is complete. Catalogue numbers, sex, locality, or any desired data can then be added, and the finished sheets with their skins filed in a plant press under moderate pressure to prevent any slight curling which may ensue.

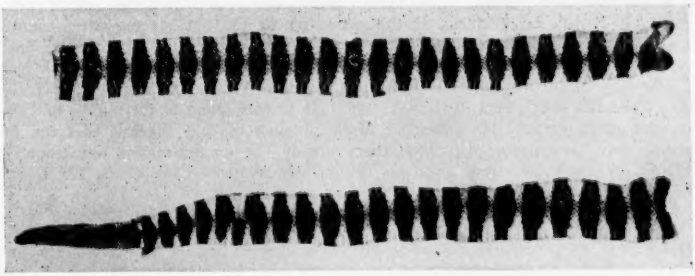

Fig. 1. *Micrurus mipartitus;* Dept. Tropical Research No. 30914; Rancho Grande, Venezuela. Mounted skin (dark shaded head and tail are bright scarlet).

The skinned body may be examined for sex, stomach contents or embryos, labelled and preserved in alcohol as usual.

If the common coral snake of Rancho Grande, *Micrurus mipartitis,* is placed in alcohol, all trace of the scarlet head and tail disappears completely, sometimes in less than a week. Corresponding colored areas in coral snakes mounted as dry skins in 1920 are today as bright as in life.

Among other advantages, the body colors and patterns are exceedingly clear on the flattened surface, whereas in the preserved, shrunken, rounded serpent they are often difficult to see and describe. The detection of areas of natural dermal elasticity, as in the neck of cobra-like types with their hidden pattterns and colors, are plainly visible.

Counts of varying scale rows, often obscure on the preserved body, become visible and easily determined on the flattened expanse. With ordinary care in spreading, it will be found that the total lengths in the recently dead and in the mounted skin are identical. As I have said, color descriptions in many species even of delicate shadings and hues are unchanged in the mounted skins. Whether this applies to all colors can be found out only by study of many species, so it is better to make the record of color and pattern in the living serpent as usual. I never make use of this method in preserving a unique specimen.

In short, the moisture remaining on the newly removed skin has sufficient adhesive quality to make the skin cling as tightly as if glued and varnished. Apparently no arsenical or other deterrent to mold or insect enemies is necessary.

I had thought that this simple, effective method must be well known to herpetologists, but at the suggestion of Drs. Bogert and Oliver of the American Museum I am presenting this brief résumé.—WILLIAM BEEBE, *Department of Tropical Research, New York Zoological Society, New York.*

NOTE ON THE BREEDING SEASON OF *RHACOPHORUS BUERGERI* (SCHLEGEL).—On June 7, 1946, I collected a series of *Rhacophorus buergeri* (Schlegel) at Lake Chûzenzy, Nikkô, Totiki-ken, Japan. The specimens were found along the eastern shore of the lake between Chuguchi and Utagahama at an altitude of 4167 feet (1270 m). Along this section a coastal shelf 1 to 3 feet deep extends into the lake for several yards before falling off sharply to a greater depth. This shelf is covered with rocks and boulders, and the water over it is a few degrees warmer than the lake's deeper parts, though the temperature is still near the freezing point at this season.

A series of 22 male and 2 female specimens (♂♂ AMNH-A 53098-53105 + 14 untagged; ♀♀ AMNH-A 53106-7) was collected under stones on the shelf. Although the water was so cold as to numb the collector's bare hands, the frogs were all very active and tried to swim away immediately upon being uncovered. Large numbers of males were allowed to escape, and only 2 larger females were found. One of these (53106) was in amplexus with a male. Upon being opened after preservation this female proved to have 190 eggs in her oviducts. In the second female (53107) 244 eggs were counted, 241 of which were still in the ovary while 3 had already entered the left oviduct. Snout to vent lengths of the females were 52 mm. (53106) and 47 mm. (53107), respectively.

This may mean that the breeding season, given by Yaichirô Okada (1933, Sci. Rep. Tokyo Univ. Lit. & Sci., Sect. B, 1 (15): 159–173) as "beginning to the middle of July," may start much earlier. The difference in the number of eggs suggests that the first specimen may have started depositing them already but no egg-masses were found at this time, although the entire area was thoroughly covered.—CARL GANS, *125 Cabrini Blvd,. New York 33, New York.*

RANA GRYLIO IN SOUTH CAROLINA.—Several herpetologists have suggested that *Rana grylio* Stejneger would be found in South Carolina, but specific records from that state seem to be lacking. During the last week of July, 1946, I found the species to be abundant along the Combahee River, about 7 miles east of Yemassee, Beaufort County. The frogs were found in old, flooded rice-fields, now choked with various species of aquatic plants. Individuals were calling nightly from thick clusters of floating or emergent vegetation. None was found along the dikes or river banks, although these yielded large numbers of *R. clamitans, R. pipiens sphenocephala,* and one *R. catesbeiana.* A particularly sonorous "pig-frog" apparently occupied the same spot each night, and grunted incessantly from dusk to dawn. At night, specimens could be readily approached by boat, and, blinded by the rays of a flash-light, could be seized by hand. Commonest associate of *R. grylio* in the Combahee marshes was *Alligator mississipiensis.* Many other species of reptiles and of amphibians were collected along the river bank, but none appeared to invade the rice-fields to any extent.—WILFRED T. NEILL, *Department of Biology, Augusta Junior College, Augusta, Georgia.*

NOTES ON GEORGIA SNAKES OF THE GENUS *ELAPHE*.—The species of *Elaphe* in the southeastern United States present a series of taxonomic problems that can scarcely be solved by material from one state alone, but local lists may point the way to broader investigations. The following notes are based on all Georgia specimens of *Elaphe* that have come to my attention since 1934. Four species of the genus are found in the state. Ignoring the problem of subspecies, these are *guttata, obsoleta, confinis,* and *quadrivittata.*

Elaphe guttata shows no evidence of genetic intercourse with the others. In many examples the keels are indistinct or even lacking, a condition possibly correlated with fossorial tendencies. Although the species has been described as arboreal, all my specimens were found on the ground, in mole burrows, in the debris of rotting stumps, or beneath piles of hay in and about barns. Many corn snakes hibernate in old pine stumps on higher hillsides. The species was not found in the Appalachian province, but was taken from DeKalb County in the upper Piedmont, south to the Okefinokee Swamp and east to the coast, including several of the larger islands.

Elaphe obsoleta was collected in many localities from Rabun County in the Appalachian Mountains, southward to the Fall Line, and in certain Coastal Plain areas to be discussed separately. Throughout its Georgia range, the species exhibits considerable color variation. Black examples are common, but many areas yield adults of a gray shade, with distinct markings. In the lower Piedmont a common pattern consists of a dorsal "ladder" and a lateral stripe. Quadrilineate specimens are of frequent occurrence in Fall Line localities, but these may be readily identified as *obsoleta* by the dark gray ground color. About 25 or 30 miles below the Fall Line, in southern Burke County, completely black *obsoleta* have been taken; and one spot, 11 miles west of Waynesboro, yields individuals of this color only. Burke County seems to represent the southern limit of the range of black rat snakes in the state. About 20 miles farther south, in Emanuel and Screven counties, the rat snakes are light gray with four black stripes, and with a squamation approaching that of *quadrivittata.* Postocular and interorbital stripes may be present or absent. The venter is strongly marked posteriorly with gray. Such specimens seem to indicate definite genetic intercourse between black and yellow rat snakes. About 30 miles still farther to the south, in Bulloch and Effingham counties, typical *quadrivittata* is found, its range extending thence into Florida.

Judging from the literature, the respective ranges of the black and the yellow forms are rather closely adjacent, but not overlapping, throughout the southeast. Two Florida records of *obsoleta* are very questionable, as indicated by Carr (1940, Univ. Fla. Pub., 3: 81). Intermediates have been noted by several workers. Thus Cope (under the name *Coluber* for this genus) describes his subspecies *lemniscatus* as being "intermediate between the *C. quadrivittatus* and the *C. obsoletus*"; and states that, while some specimens approached "*obsoletus*" others were distinguishable from the yellow form only by a darker coloration, and a broader lateral stripe (1898, Ann. Rep. U.S. Nat. Mus.: 849).

The situation is complicated by the widespread occurrence of light gray, spotted rat snakes. I have seen several such from the upper Piedmont. The upland specimens, however, are darker than typical *confinis,* and occur as isolated individuals in colonies of normal *obsoleta.* They seem to be black rat snakes that have retained the juvenile coloration longer than usual. True *confinis* is apparently lacking from the Georgia Piedmont. Populations of very light, spotted rat snakes are found from the Coastal Plain side of Augusta, Richmond County, southward for a distance of about 50 miles. No *confinis* was collected in the lower Coastal Plain, within the range of *quadrivittata.* It presumably occurs there, however, since gray rat snakes are widespread in northern Florida (Carr, *op. cit.*: 82).

A further complication is introduced by the type locality of *confinis,* supposedly Anderson, South Carolina. I have long suspected that Anderson was merely the shipping point for specimens sent to the U.S. National Museum by Miss Charlotte Paine (Mrs. M. E. Daniels); and that many of these were actually taken much farther south. Miss Paine's material included, in addition to *confinis* and "*Coluber spiloides,*" such forms as *Hyla andersonii* and *Farancia a. abacura.* While it is conceivable that these species range into the Piedmont along the Savannah River Valley, I have seen no evidence that any of them does so. It is scarcely credible that all should extend their distribution

in this region to a point only 30 miles below the Appalachian Mountains. Some doubt is thus cast over the entire assemblage.

Elaphe confinis may differ in squamation from northern *obsoleta*, but in Georgia the trend of *obsoleta* toward *quadrivittata* results in an increased number of subcaudals and fewer keeled dorsal scale rows, thus duplicating *confinis* characters in many thoroughly black examples. Number of scale rows, of infralabials, and of temporals do not appear to be diagnostic. Color remains the sole criterion for the separation of the black and the gray forms in the area under consideration, and many specimens can not be definitely allocated even on this basis. Intermediate types are common in several areas of southern Richmond and northern Burke counties, Georgia, and of Aiken County, South Carolina. I know of no locality where the black and the light gray forms occur together. It appears that a hybrid population is developed when ecological conditions are suitable for both races.

Some *confinis* show tendencies toward a lineate pattern and others lack head markings, but none has been seen that could be considered intermediate between this race and *quadrivittata*. Such snakes probably exist, however; Strecker has noted them from Louisiana (1926, Cont. Baylor Univ. Mus., 8: 5), and some from Florida are difficult of allocation. Some descriptions of *confinis* are not applicable to Georgia specimens, which are light gray or whitish, with irregular gray dorsal blotches and elongate lateral blotches that are sometimes confluent anteriorly. Haltom's figure, presumably of an Alabama individual, differs from any *confinis* that I have seen from Georgia (1931, Ala. Mus. Nat. Hist. Paper 11: plate 11).—WILFRED T. NEILL, *Department of Biology, Augusta Junior College, Augusta, Georgia.*

HERPETOLOGICAL RECORDS FROM LOGAN COUNTY, OHIO.—During the last two years I have had the opportunity to collect near Indian Lake, Logan County, Ohio. Many new distribution records can be added to those of Conant (1938, Reptiles of Ohio) and Walker (1946, Amphibians of Ohio, Part I). They are as follows:

Acris crepitans (Baird).—Collected July 29, 1946, at a small pond about 2½ miles southeast of Indian Lake.

Rana clamitans (Latreille).—Collected July 16, 1945, along a small stream about 2 miles southeast of Indian Lake.

Rana pipiens Schreber.—One collected September 3, 1945, by a small stream 1 mile north of Huntsville. Many collected July 29, 1946, at a pond 2½ miles southeast of Indian Lake.

Coluber constrictor constrictor (Linnaeus).—Two collected May 5, 1946, in a meadow about ¼ mile south of the lake. These are integrades between *C. c. constrictor* and *C. c. flaviventris*.

Elaphe obsoleta obsoleta (Say).—Collected September 3, 1945, on the bank of a canal along the east side of the lake. This is the first specimen of the species recorded from Logan County.

Lampropeltis triangulum triangulum (Lacépède).—One found DOR July 5, 1945, about ¼ mile southeast of the lake.

Natrix kirtlandi (Kennicott).—Three found June 11, 1945, along the east shore of the lake, the first record of this species from Logan County.

Natrix septemvittata (Say).—Many collected June 11, 1945, along the east shore of the lake. Two collected August 8, 1946, at a pond 2½ miles southeast of the lake; another taken September 3, 1945, by a small creek 1 mile north of Huntsville.

Natrix sipedon sipedon (Linnaeus).—Collected July 29, 1946, by a stream 2 miles southeast of Indian Lake.

Thamnophis sirtalis sirtalis (Linnaeus).—A large female collected July 29, 1946, in a deserted house about 3 miles south of the lake.

Chrysemys bellii marginata (Agassiz).—A young specimen collected July 6, 1945, in a small pond 2½ miles southeast of the lake.—WM. E. DUELLMAN, *436 Greenmount Blvd., Dayton 9, Ohio.*

EGG LAYING OF *TRIONYX FEROX*.—On March 30, 1940, I had the good fortune to witness the egg-laying habits of the southeastern soft-shelled turtle, *Trionyx ferox*, 6 miles southeast of Fort Myers, Florida. The site was a sandy roadbed slightly above the cypress swamp and ditch levels on either side of the road. Five turtles were observed at irregular intervals along a 3-mile stretch and observation made on 2 of these turtles. The turtles proceeded with their reproductive duties even when we stood a few feet from them, evidencing no concern. The largest, an individual with a carapace 13 in. long and 10 in. wide, was laying at 11 A.M. in bright sun. In a period of three minutes, 4 eggs were deposited in the nest chamber. On removing this turtle, a total of 7 eggs was recovered from the nest. These were lightly covered with sand, the eggs being successively covered by scraping sand into the burrow with the hind feet. The entrance to the egg chamber was surprisingly small, sufficiently large to barely permit the passage of an egg. The interior was somewhat more spacious, the bottom, at a depth of 5 inches, being about the width of a quart milk bottle. A somewhat smaller turtle was observed excavating a nest chamber, the hind feet being employed alternately in removing the moistened sand. Since the sand in the chamber was damper than the surrounding earth, it appears probable that cloacal water is utilized to soften the earth, as has been observed with other turtles. Cahn (1937, Univ. Ill. Bull., 35(1): 192) has noted such a condition in the nests of *Trionyx spinifera*. Cahn further relates that the nest excavation of *spinifera* descends at an angle of 60°, the opening of the surface lying under what is approximately the middle of the plastron while the reptile is digging the hole. The turtles which we observed all chose the ruts formed by cars or the slope of the roadbed, the plastron thus being directed at an angle of approximately 50° to 70°. No incline into the nest cavity was noted. On March 21, at 5 P.M. following a heavy rain, we found another nest-building turtle. This individual, with a carapace 10.5 in. long and 9 in. wide, had made two excavations 8 inches apart similar to the ones found the previous day. Neither of these excavations had eggs. The turtle contained 17 well developed eggs.

Harper (1926, American Speech, 1: 415) states that in the Okefinokee Swamp of southeastern Georgia, this species, upon completion of egg-laying, goes a few yards and pauses long enough to scratch up the ground vigorously, scattering the earth about and so leaving a conspicuous trace of its presence. This Harper believed to serve the purpose of drawing the attention of marauding animals away from the exact spot where the eggs have been concealed. I saw no evidence of such behavior. Predation was very apparent. Along the road for 6 miles or more, scattered egg shells from the excavated nests were evident. The tracks of spotted skunk, raccoons, and foxes were seen in the sand about such destroyed nests. From 4 to 14 egg remains were observed at each of more than 20 nests. A rancher, Dwight Dyess, informed me that he had seen no egg sites thus destroyed prior to March 30, while 3 days previously we had travelled the same road and seen no evidence of predator activity. Spherical eggs from a large turtle average 27 mm. in diameter. From a turtle whose estimated weight was 6 pounds, we removed 21 fully developed eggs and more than 50 ovarian eggs approximating a marble in size. Goff and Goff (1935, COPEIA, 1935: 156) took a 31¼ pound female on May 19 containing 20 well developed eggs. Carr (1940, Univ. Fla. Biol. Sci. Serv., 3: 107) states that the eggs of this species are laid in Florida from March to July 10.

Daily temperatures at the time of these observations averaged 85° F., the first really warm spell of the season.—W. J. HAMILTON, JR., *Cornell University, Ithaca, New York.*

HIBERNATION OF THE LINED SNAKE.—In January, 1943, I lived in a suburb of Dallas, Texas. During the mild weather of the first two weeks, my family and I dug up a small garden patch of black gumbo, a sticky clay, thickly grown to Johnson grass, *Sorghum halepense*. At a depth of 6 to 8 inches, we uncovered seven hibernating lined snakes (*Tropidoclonion lineatum*) in a plot of 1200 square feet. Four of the snakes were in an area the size of a dinner table. The snakes were coiled, one ring upon another, similar to preserved specimens coiled to fit into a small jar. The head of the snakes inclined slightly into the center of the circle formed by the coils. On exposure to bright sunlight for an hour, at a temperature of 76° F., the snakes showed little movement, retaining their hibernating pose. On January 19 an unprecedented cold spell occurred with temperatures of 7° F.

This observation suggests that the species is somewhat communal in its hibernating behavior. Similar habitat encompassed more than 2 acres.—W. J. HAMILTON, JR., *Cornell University, Ithaca, New York.*

A RECORD *CRYPTOBRANCHUS ALLEGANIENSIS.*—On Sunday, September 1, 1946, while visiting in the Great Smoky Mountains National Park in Tennessee, a female specimen of *Cryptobranchus alleganiensis* was taken from the Little Pigeon River. This clear, cold mountain stream rises on the east side of Newfound Gap, between Mt. LeConte and Clingmans Dome and follows a course down through the village of Gatlinburg, Tennessee. The specimen was taken in the limits of the village and just outside the National Park boundary as it climbed out on a rock, presumably to sun. Sometime during the night of September 1, over 200 eggs were laid in a large tub in which the specimen had been placed. The specimen measured 740 mm. in total length; width of the head 90 mm. This is 54 mm. longer than the largest specimen mentioned in Bishop's recent *Handbook of Salamanders* (p. 61). The specimen was presented to the natural history collection of the Smoky Mountain National Park.—FRANK W. FITCH, JR., *Department of Fish and Game, Texas A. and M. College, College Station, Texas.*

AN ALBINO *AMPHIUMA.*—An albino of the species *Amphiuma means tridactylum* Cuvier, was collected in Audubon Park, New Orleans, Louisiana, May 18, 1946. The individual, an adult male, 44 cm. in total length, is normal except for the complete absence of the dark pigment. The many minute yellowish spots present in the usual pattern are accentuated in the albino. This is the only albino specimen observed among more than 300 individuals of the species seen in Audubon Park during April–August, 1946, where the population has been under observation of the Zoology Department of Tulane University for many years. Retained in captivity with a normally pigmented animal of the same size, the albino displayed no apparent difference in sensitivity to light or in the feeding reaction. The specimen is preserved in the Tulane Collections in Vertebrate Zoology.—FRED R. CAGLE, *Department of Zoology, Tulane University, New Orleans, Louisiana.*

SNAKES EATING BATS.—The diet of many snakes includes a number of rodents and other mammals such as shrews, moles, weasels, and opossums. Few snakes are known to eat bats. Silver (1928, Jour. Mammal. 9(2): 149) mentions a pilot black snake, *Elaphe o. obsoleta,* captured up under the roof of a building where bats were roosting, which was subsequently found to have been feeding on these animals. Carr (1940, Univ. Fla. Publ., Biol. Ser., III, No. 1: 82) refers to several chicken snakes, *Elaphe q. quadrivittata,* found hanging from stalactites and in crevices in the ceiling of a cave inhabited by thousands of bats. No doubt there are other arboreal snakes that occasionally eat bats.[1]

The present note concerns a captive corn snake, *Elaphe g. guttata,* and a captive pilot black snake, *Elaphe o. obsoleta,* that have been fed bats on several occasions. Two species of bats were eaten, the large brown bat (*Eptesicus f. fuscus*) and the Georgian bat (*Pipistrellus s. subflavus*). In each instance the bats were immediately seized and usually constricted before swallowing was begun. Swallowing was accomplished almost as easily as with other mammalian prey except that the presence of the wings made it somewhat more awkward. Both of these individual snakes also eat birds. The readiness with which these aboreal snakes accepted bats suggests that they encounter and capture these mammals with some frequency under natural conditions. A captive king-snake, *Lampropeltis g. getulus,* consistently refused to eat bats despite the fact that its diet includes, among other animals, small mammals superficially similar to bats. This suggests that because of its terrestrial habits bats do not constitute a normal part of its food.—J. A. FOWLER, *Biology Department, Sidwell Friends School, Washington, D.C.*

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1 Uhler, Cottam and Clarke (1939, Trans. Fourth N. Amer. Wildlife Conference: 610) record a bat from the stomach of a rattlesnake (*Crotalus h. horridus*) collected in the George Washington National Forest, Virginia.

NOTES ON *GOPHERUS BERLANDIERI* (AGASSIZ).—Gunter (1945, COPEIA, 1945: 175) has recently discussed the northern and eastern range extensions of the predominantly lower Rio Grande Valley *Gopherus berlandieri*, defining the limits of its distribution in Texas as Refugio and Aransas counties in the east, and Atascosa and Bexar counties in the west. We are now able to report that this species extends into Medina and Uvalde counties, some 100 miles due west of San Antonio. On June 12, 1946, we observed 4 DOR specimens and 2 live specimens (AOR) while driving from northern Uvalde County to San Antonio. Specific localities are, UVALDE COUNTY: 5 miles north of Laguna (DOR), Sabinal (AOR), Knippa (AOR); MEDINA COUNTY: 6.4. miles west of D'Hanis (DOR), 5 miles east of Hondo (DOR), 3.5 miles west of Castroville (DOR). Two of these localities, Laguna and Knippa, are respectively within and immediately adjacent to the Edwards Plateau, which represents a drastic ecological departure from the normal habitat of *berlandieri* in the lower Rio Grande Valley and the West Gulf Coastal Plain.

Four other specimens from Mexico, in the Texas Cooperative Wildlife collections, housed in the Department of Fish and Game, Texas Agricultural and Mechanical College, are from 20 km. northwest of Montemorelos; 50 km. south of Nuevo Laredo; and 10 km. northeast of Montemorelos. These localities are all within the Rio Grande drainage, and approximate an elevation of 1500 feet.

This species has been observed to feed heavily on the ripe fruit of the common cactus (*Opuntia leptocaulis*) during the summer, while at other times it appears to subsist largely upon young shoots and highly-colored blossoms of a variety of plants.

Contrary to the findings of Bogert and Oliver (1945, Bull. Amer. Mus. Nat. Hist., 83: 398–399), an analysis of 14 males and 13 females of *berlandieri* from Texas and Nuevo Leon reveals a prominent sexual dimorphism in certain proportions. Thus, we find that the ratio of the diameter of the hind foot to the head width shows a total range for all specimens of 57.1 per cent to 89.3 per cent, with a mean of 75.0 per cent. The 14 males vary from 69.5 per cent to 89.3 per cent (mean 78.7 per cent, while the 13 females range from 57.1 per cent to 81.2 per cent (mean 70.9 per cent). Only 2 males have a ratio of less than 74 per cent, the remaining 12 specimens ranging from 74 per cent to 89.3 per cent; conversely, 9 females have ratios of less than 74 per cent, and 4 have ratios varying from 78 per cent to 81.2 per cent. That these disparate spreads indicate a significant sexual dimorphism is demonstrated by the chi-square test, which results in a value of 8.43 ($P = < .01$).

The ratio of carapace width to carapace length (straightline) clearly exhibits sexual dimorphism. The range of this ratio in all specimens is 73.2 per cent to 101.5 per cent, and the mean is 85.3 per cent. The 14 males vary from 73.2 per cent to 90 per cent (mean 82.1 per cent), while the 13 females vary from 79.0 per cent to 101.5 per cent (mean 96.1 per cent). Nine males have ratios of 82 per cent or less, while only one female has a ratio lower than 83 per cent. The chi-square test of these dispersions results in a value of 9.25. In the ratio of shell depth to carapace length, the range for all specimens is 49 per cent-71.7 per cent (mean 55.5 per cent), males varying from 51.5 per cent to 60.6 per cent (mean 55.7 per cent), and females ranging from 49 per cent to 71.7 per cent (mean 55.3 per cent), thus with no indication of sexual difference.—M. B. MITTLEMAN, *470 Pelham Road, New Rochelle, New York*, and BRYCE C. BROWN, *Texas Agricultural and Mechanical College, College Station, Texas.*

GRAPTEMYS GEOGRAPHICA IN WEST VIRGINIA.—The occurrence of the map turtle, *Graptemys geographica* (Le Sueur), in West Virginia has been suspected for some time. M. Graham Netting gave it hypothetical status in his mimeographed "List of amphibians and reptiles of West Virginia" (Section of Herpetology, Carnegie Museum, Pittsburgh) until the eighth (July 1, 1946) revision.

Apparently the first record for this species in West Virginia supported by an actual specimen is a shell found by myself, October 8, 1946, near the head of Cheat Lake, Monongalia County, at an elevation of 900 feet. The carapace measured 101 by 81 mm., indicating an established individual.

Mr. Netting has verified the identification of the shell, which has been deposited in the Carnegie Museum.—W. GENE FRUM, *425 High Street, Morgantown, West Virginia.*

THE FOOD OF THE WESTERN CRICKET FROG.—The western cricket frog (*Acris crepitans* Baird) is a conspicuous and common inhabitant of small ponds in the springtime in eastern Kansas. In the period between March 3 and April 14, 1946, they were observed in several localities in Douglas County, and specimens were preserved for a subsequent study.

The contents of each stomach were emptied into a watch glass, and the volumetric percentage of each item was estimated. Ninety-four specimens were available; 67 of these were taken in Kansas, and 27 were collected by Dr. E. C. Raney in October, 1945, near small streams in the vicinity of Lincoln, Nebraska, and since the stomachs of the two series were similar in their contents, they are summarized together in Table I. For the identification and information concerning the Collembola I am indebted to Dr. F. Bonet-Marco.

TABLE I

AN ANALYSIS OF THE FOOD OF 63 CRICKET FROGS

Food item	No. of stomachs containing item	Percentage of stomachs containing item	Total no. of item in all stomachs	Percentage by volume
Arachnida	26	41.3	36	23 8
Hexapoda				
Collembola	3	4.8	216	.2
Hemiptera	13	20.6	13	6.5
Homoptera	2	3.2	2	4
Coleoptera	50	79.5	62	54.6
Diptera	15	23.8	18	11.9
Hymenoptera	4	6.4	5	.1
Undet.	6	9.5	...	2.4
Plants	3	4.8	3	.1

Although the contents of such a small series of stomachs taken in only two seasons do not give a complete picture of the diet of *Acris crepitans*, they do indicate the places in which these frogs obtain their food. One half of the food was composed of beetles, of which the larvae of water-beetles (*Dytiscus* sp.) were the most common. They were present in 31 stomachs, and in 5 of these they formed the sole item. Small spiders made up almost one quarter of the food. Third in abundance were Diptera, the majority of which were larvae of midges (Chironomidae) and muscids (Myodaria). The Hemiptera present were mostly water-boatmen (Corixidae). Springtails (Collembola) occurred in 3 stomachs, and one frog had eaten more than 200. The most frequent species was *Isotomurus retardatus* Folsom, although *Sminthurides aquaticus* var. *levanderi* (Reuter) and *Podura aquatica* L. were found in smaller numbers. These springtails live on the surface of the water. Plant remains consisted of a seed of alder (*Alnus rugosa*), a seed of smartweed (*Polygonum* sp.), and a small fragment of an unidentified leaf.

Smith (1934, Amer. Midl. Nat., 15: 377–370, 427–528), summarizing the knowledge of the food of *Acris crepitans*, stated that both aquatic and terrestrial insects are eaten. Bragg (1943, Gt. Basin Nat., 4: 62–80) remarked on the agility of this frog in jumping for flying insects. This ability may account, in part at least, for the muscoid flies and other flying insects found in the cricket frog stomachs in this study. The majority of food items, however, are aquatic insects, many of which are bottom dwellers. Most of the feeding is done in the water, both at the surface and on the bottom.—E. W. JAMESON, JR., *Department of Zoology, Cornell University, Ithaca, New York.*

Reviews and Comments

QUEST FOR THE GOLDEN CLOAK, AND OTHER EXPERIENCES OF A FIELD NATURALIST. By Alvin Seale. Royal octavo, vii + 135 pp. Printed for the author at Stanford University Press, Stanford University, Calif. 1946.—In 1892, a nineteen-year-old Indiana boy, imbued with the desire to study under David Starr Jordan at newly-opened Stanford University, set out for California on his bicycle. Three months later, Alvin Seale rode up to the Stanford Quad, got off his bicycle amidst a crowd of admiring students, who had never seen a pneumatic-tired "bike" before, and presented himself in Dr. Jordan's office for admittance to the University. Thus began the most colorful career of any of Jordan's numerous ichthyological students.

The beautifully printed and strikingly bound book before us presents Alvin Seale's own story of his travels and adventures. He built the fifth house in Palo Alto, and before long was supporting himself by collecting oceanic birds off Monterey. While other students desired to get their degrees quickly, Seale was always ready for adventure, and there was plenty of opportunity. Before his bachelor's degree was granted in 1905, he had been to Point Barrow, Bering Sea, the Mackenzie River, Hawaii, the Marquesas, the Solomons, Rarotonga, Australia and New Zealand, and had been a sourdough in the Klondike to boot. The greatest of his travels were made for the Bishop Museum, collecting ethnological and biological material, and searching for feather cloaks of the Polynesian kings. Later Seale was Director of Fisheries for the Philippines, Curator of Fishes at Harvard, and, more recently, Superintendent of the Steinhart Aquarium in San Francisco, where "A. Seale, address: The Aquarium," was a never ending source of merriment, not only to the public, but to Seale himself.

Now living in retirement near Watsonville, California, Alvin Seale has given us this book. Our only criticism is that 135 pages are very few for the presentation of so much! Five times that many would scarcely have done justice to such a life. The book closes with a useful bibliography of the author's publications.—George S. Myers, *Natural History Museum, Stanford University, California.*

NORTHERN FISHES WITH SPECIAL REFERENCE TO THE UPPER MISSISSIPPI VALLEY. By Samuel Eddy and Thaddeus Surber. Univ. of Minnesota Press, Minneapolis. Second Ed., Revised, 1947: i–xii, 1–276, figs. 1–57 (4 colored). $4.00.—Ichthyologists and fishery workers alike are repeatedly embarrassed by their inability to meet the needs of students, fishermen, and laymen for regional or comprehensive works on fishes. During the past two decades the gap has broadened between ichthyological knowledge and adequate media for its dissemination. Eddy and Surber have done much to bridge this gap, especially for the fishes of Minnesota and adjacent areas. The enthusiastic reception of this volume is indicated by the early exhaustion of the original printing (1943).

In the second edition the introductory chapters dealing with fishing, fish management, lake dynamics, and problems of conservation and utilization have been amplified and largely rewritten. The material is presented with clarity and simplicity, and probably approximates the average opinion of fishery research workers on the principal problems of fresh-water fishery management. These chapters are up-to-date and largely free from error (slips such as ". . . the principal source of oxygen in lake water is from the aquatic plants" are infrequent). More generous use of illustrations would have helped to leaven the discussion.

The accounts of the 167 fishes, as well as the figures, are in large part the same as in the original edition. However, many errors in the first printing have been corrected, and the list of species has been increased by recent discoveries. The systematic nomenclature is strictly modern. The keys and descriptive accounts are largely rewritten or adapted from other works, but there is much original information on habits, ecology, and behavior. There is a useful bibliography of 118 titles and an index.—Reeve M. Bailey, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

REPTILES AND AMPHIBIANS OF THE NORTHEASTERN STATES. By Roger Conant. Zoological Society of Philadelphia, Philadelphia, Pennsylvania. 41 pages. 123 illustrations. $1.00.—Herpetologists may be casually divided in two kinds: those who take pleasure in popularizing the study of reptiles and amphibians, and those who don't. Roger Conant is an outstanding example of a herpetologist who can give information to the layman as well as to the technical student.

Reptiles and Amphibians of the Northeastern States is written in a pleasing style and gives the kind of facts that the average person wants. The excellent photographs make detailed descriptions unnecessary. The large size of the pages allows several illustrations to be arranged around the simplified descriptions and greatly facilitates comparison with a specimen in hand.

In addition to these double pages of pictures and descriptions there is a general introductory page, a check-list of the 87 northeastern species and subspecies with their ranges, a map, a section on the treatment of snake bite, one on the care of captive specimens, a list of references, an index, and, most important of all, a brief but valuable account of each group of animals: snakes, lizards, turtles, salamanders and frogs.

The large size and soft covers keep this book from wearing well and make it inconvenient for use in the field; this is my only adverse criticism.—CLIFFORD H. POPE, *Chicago Natural History Museum, Chicago, Illinois.*

FISHES OF THE PACIFIC COAST OF CANADA. By W. A. Clemens and G. V. Wilby, Fisheries Research Board of Canada, Bulletin LXVIII, Ottawa, 1946, 368 pp., 253 figures.—Seldom is a taxonomic work written that is highly useful to both the scientist and the layman. This work contains a key to the 245 species from 77 families that are included, and each species is illustrated in black and white. Eight figures are given to illustrate the various technical terms used. These figures in conjunction with an excellent 5-page glossary plus 8 pages of careful definition of all counts and measurements make the work fully understandable, even to those with no previous training in ichthyology.

The descriptions are thorough but written in simple, understandable language, and the text itself is not cluttered with bibliographic references to synonymy, although an 8-page bibliography follows the text. It fulfills a great need by bringing together descriptions scattered throughout dozens of journals. The authors have shown a highly commendable fortitude in not recognizing every geographically isolated population under a separate name. Only four trinomials appear. Some may question their grouping of families, e.g., the anchovies are placed under the Clupeidæ. Most of the species described are found either in Alaska or on the Pacific coast of the United States so that the bulletin is a must for anyone interested in Pacific coast fishes. It would also be an extremely useful adjunct to any course in ichthyology.—GEORGE A. ROUNSEFELL, *Fish and Wildlife Service, Washington, D.C.*

NEW ANGLERS BOOKS

A FULL CREEL. By Henry Marion Hall. Longmans, Green and Co., New York, 1946, i–x, 1–181; $3.00.—A collection of angling reminiscences reprinted from *Rod and Gun, Forest and Stream, Outdoor Life,* and other periodicals.

FISHING LAKE AND STREAM FOR BASS, MUSKALONGE, PIKE, PAN FISHES, SALMON AND TROUT. Edited by Ray Schrenkeisen. Doubleday and Company, Garden City, New York, 1946, 185 pp., several figs.; $2.00.—This handbook of angling methods is the work of a group of famous fishermen. It is a combination of two books published several years ago and reviewed in these pages—*Fishing for Bass, Muskalonge, Pike and Pan-fishes,* and *Fishing for Salmon and Trout.*

WATERS OF THE GOLDEN TROUT COMPANY. By Charles McDermand. G. P. Putnam's Sons, New York, 1946.—This book recounts the author's experiences fishing for golden trout in Kings Canyon and Sequoia National Parks. Much of it is reprinted from articles in *Field and Stream, Outdoor Life,* and other sporting magazines.—L. A. WALFORD, *U. S. Fish and Wildlife Service, Washington, D.C.*

EDITORIAL NOTES AND NEWS

Dr. Willy Wolterstorff

DR. WILLY WOLTERSTORFF, Curator at the Magdeburg Museum für Naturkunde und Vorgeschichte, died January 21, 1943, at the age of 79. He was known especially for his interest in salamanders, but was especially the friend of the younger generations of herpetologists everywhere in Europe through his editorship of the *Blätter für Aquarien—und Terrarienkunde* and the *Wochenschrift für Aquarien—und Terrarienkunde.*

Dr. Wolterstorff was brought up in a geological home atmosphere and contributed to the knowledge of the Magdeburg terrain. It was natural that he should turn to extended studies of fossil frogs, especially of the genus *Paleobatrachus,* published in 1886. His studies extended to Crustacea, Mollusca, various groups of lower vertebrates, and mammals. At an early age he began to specialize upon salamanders, on which he published almost 300 papers, together with numerous notices, replies to queries, etc., in the journals published under his direction. He devoted himself especially to the keeping of living salamanders and to observation of their breeding habits. The demonstration that *Triturus blasii,* occurring in nature, is a natural hybrid between *Triturus marmoratus* and *T. cristatus* was one of his early successes. Wolterstorff had a sharp eye for significant variation, and described numerous forms from Europe, Asia, and North America that now find their place as valid subspecies. He contributed a constant succession of stimulating faunal papers tending toward exact knowledge of the distribution of the amphibians and reptiles of Central Europe. More than this, he was a far-sighted proponent of the intelligent combination of morphological and ecological studies.

Dr. Wolterstorff labored under the handicap of deafness from the age of seven. The high quality of his mind is shown by the fact that he nevertheless acquired a command of Latin, Greek, French, and English.

The great salamander collections at Magdeburg and the special library accumulated for their study, which were to form the best memorial to Dr. Wolterstorff, were unhappily destroyed in the last years of World War II; it was thus perhaps fortunate that Dr. Wolterstorff did not live to witness this calamity. The American Society of Ichthyologists and Herpetologists lost in him one of its most appreciative honorary members. —GÜNTHER FREYTAG, *Magdeburg 19, Kaiser-Friedrichstr. 15, Saxony* (*Russian Zone*).

News Notes

DR. HUBERT LYMAN CLARK died in Cambridge on July 31, 1947, at the age of 77. While holding a professorship at Olivet College, Michigan, from 1899 to 1905, Dr. Clark developed an enthusiastic interest in the distribution and variations of snakes, an interest continued throughout his life. After leaving Olivet, he went to the Museum of Comparative Zoology, where he became one of the world's foremost specialists on the embryology, taxonomy, morphology and distribution of echinoderms. Only last year he published a large monograph on the echinoids of Australia, and worked vigorously at the Allan Hancock Foundation of the University of Southern California on the echinoid collections.

DR. RAYMOND E. JOHNSON, formerly Aquatic Biologist, has been appointed Research Supervisor of the Fisheries Research Unit, Minnesota Department of Conservation, St. Paul, to replace DR. LLOYD L. SMITH, JR., who joined the National Park Service as Aquatic Biologist, and has recently been appointed Associate Professor of Economic Zoology, Division of Entomology and Economic Zoology of the University of Minnesota, University Farm, St. Paul 1.

DR. CHARLES WALKER, formerly a member of the staff of the Stone Laboratory, Ohio State University, has been appointed Associate Curator of the Herpetology Division of the Museum of Zoology, University of Michigan, Ann Arbor.

DR. NELSON MARSHALL, formerly a member of the staff of the University of North Carolina, has been appointed Director of the Virginia Fisheries Laboratory, Williamsburg.

A second expedition to Bikini Atoll in the northern Marshall Islands was made this summer, the chief objective being to try to evaluate the effects of the two atom bomb explosions and to continue the exploration of the fisheries of that region. The attack troop ship *U.S.S. Chilton* sailed from San Diego July 1 with 55 scientists aboard (some of these were taken aboard at Pearl Harbor). Bikini Atoll was reached July 16. The ichthyological and fishery section includes: LEONARD P. SCHULTZ, GEORGE S. MYERS, OSGOOD R. SMITH, VERNON E. BROCK, JOHN C. MARR, three commercial fisherman, and two Hawaiians. Operations are expected to be completed by about September 1. By the end of the first month, Dr. Schultz reported the capture and preservation of a manta ray (9 ft. 8 in. diam.), a 100-lb. stingray (*Urolophis*), and several smaller species not taken on the Crossroads Operation in 1946.

DR. C. PAVAN writes from Universidade de São Paulo that the Rockefeller Foundation is providing him with a station wagon for a continuation of his field studies on the blind catfishes of Brazil.

In a recent letter to DR. RALPH HILE, DR. WILHELM NÜMANN, Director of the Institut für Seenforschung und Seenbewirtschaftung der Kaiser-Wilhelm-Gesellschaft at Langenargen am Bodensee (Württemberg), states that Dr. Hans-Joachim Elster, former Director, has been removed on political grounds and is no longer engaged in fishery work. Discharged from service also have been Dr. Erich Wagler, München, and Dr. Oskar Haempel, Vienna. Dr. Nümann advises further that DR. GEORG SURBECK, eminent Swiss fishery biologist, has been dead for several years.

The Institut, which is in the French zone of occupation, can receive reprints from the United States but can send exchanges only by way of individuals located in the American zone.

DR. STANLEY GRESSITT has returned to Lingnan University, Canton, China, where he is occupied in teaching and museum work. He writes that the museum suffered little during the war, most of the damage being due to rat depredations. He has made two short collecting trips, one to Hainan Island, the other to a mountain in northern Kwangtung Province, and planned another trip to Formosa during the summer.

DR. ROBERT R. MILLER returned the end of May after two and one-half months on a second and final ichthyological survey of the fresh waters of Guatemala. One month was spent examining the little-known streams and esteros of the Pacific coastal plain. Additional work was carried out in several independent streams and lakes of the Caribbean coastal plain and in certain areas of the highlands. Over 50,000 specimens are now available for study.

LOREN P. WOODS, now temporarily Associate Curator of Fishes at the U. S. National Museum, has been appointed Curator of Fishes of the Chicago Natural History Museum, effective April 1, 1947.

FENTON CARBINE, formerly Biologist on the staff of the Institute for Fisheries Research, Michigan Department of Conservation, Ann Arbor, and DR. EARL S. HERALD, recently assigned to the United States National Museum, Washington, have taken positions with the U. S. Fish and Wildlife Service in its Philippine rehabilitation program. These men may be addressed at A.P.O. No. 900, % Postmaster, San Francisco, California.

Sardine Research

LEGISLATURE just passed in California provides for expanded research on the sardine supply. To finance this work an additional privilege tax of 50 cents a ton on canned sardines has been levied and an appropriation of $300,000 has been made to the UNIVERSITY OF CALIFORNIA for fishing researches to be conducted by SCRIPPS INSTITUTION OF OCEANOGRAPHY. The researches to be carried on under the tax will be administered by a committee of 9 members, to be appointed by the Governor. Three sea-going vessels will be available for these investigations. The FISH AND WILDLIFE SERVICE and the CALIFORNIA DIVISION OF FISH AND GAME will co-operate actively.

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